SIEMENS TRAFFIC CONTROLS
Sopers Lane
Poole
Dorset
BH17 7ER

667/HB/27880/000

SYSTEM/PROJECT/PRODUCT: ST700

SIEMENS ST700 GENERAL HANDBOOK

PREPARED: Paul Keeping
FUNCTION: Group Leader

APPROVED: Dave Martin
FUNCTION: Engineering Manager

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WARNING

These (this) controller(s) require specific configuration to enable them (it) to function correctly when installed.

The configuration process is a complex activity should only be carried out by persons who are adequately trained, have a full understanding of the needs of the county or region where the controller is to be used and are experienced in the tasks to be undertaken.

SAFETY WARNING

HEALTH AND SAFETY AT WORK

DISCONNECT ALL POWER TO THE CABINET BEFORE REMOVING OR INSTALLING ANY EQUIPMENT INTO THE CABINET.

Safety of Maintenance Personnel

In the interests of health and safety, when using or servicing this equipment the following instructions must be noted and adhered to:

(i) Only skilled or instructed personnel with relevant technical knowledge and experience, who are also familiar with the safety procedures required when dealing with modern electrical/electronic equipment are to be allowed to use and/or work on the equipment. All work shall be performed in accordance with the Electricity at Work Regulations 1989.

(ii) Such personnel must take heed of all relevant notes, cautions and warnings in this Handbook and any other Document or Handbook associated with the equipment including, but not restricted to, the following:

(a) The equipment must be correctly connected to the specified incoming power supply.

(b) The equipment must be disconnected/isolated from the incoming power supply before removing any protective covers or working on any part from which the protective covers have been removed.

(c) This equipment contains a Lithium battery that must be disposed of in a safe manner. If in doubt as to the correct procedure refer to the Siemens instructions CP No. 526.

(d) Any power tools must be regularly inspected and tested.

(e) Any ladders used must be inspected before use to ensure they are sound and not damaged.

(f) When using a ladder, before climbing it, ensure that it is erected properly and is not liable to collapse or move. If using a ladder near a carriageway ensure that the area is properly coned and signed.

(g) Any personnel working on site must wear the appropriate protective clothing, e.g. reflective vests, etc.

In the event of more than one person working on the Controller and its associated signal heads, the Mains Supply to the Cabinet Assembly must be switched off. If the master switch has a lock, this should be used to keep the switch locked in the ‘off’ position.

In countries where both sides of the incoming supply are above earth potential, the Master Switch or Circuit Breaker on the rear of the Cabinet should be opened, since the Controller Switch on the front of the ST700 does not isolate both sides of the supply.

When re-commissioning signals, the following sequence is recommended:

1. Switch OFF the Cabinet Assembly at the master switch
2. Switch ON the lamps on-off switch on the manual panel
3. Switch ON the Cabinet Assembly at the master switch.

More specific safety information is given within the text of the handbook, where it relates to particular activities or situations.

WARNING

To isolate the equipment the master switch must be in the "Off" position.
Switching either the Controller or the Manual Panel Signals On/Off switch to "Off" does not guarantee isolation of the equipment.

Safety of Road Users

It is important that all personnel are aware of the dangers to road users that could arise during repair and maintenance of traffic control equipment.

Ensure that the junction area is coned and signed as necessary to warn motorists and pedestrians of any dangers and to help protect the personnel working on the site.

Whilst repairing signals which are in an "all-out" condition, care must be taken to ensure that no spurious signals are lit during testing which could mislead drivers or pedestrians. Particular care is required where pedestrian audible devices are installed, to ensure that no false indications are given during, for example, cable testing. Personnel should also ensure the safety of pedestrians, especially children, who may come into contact with parts of the ST700 Rack Assembly, Cabinet Assembly or signal poles.

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1. INTRODUCTION

1.1 PURPOSE OF THIS HANDBOOK

The purpose of this handbook is to give a general description and specification of the ST700 Rack Assembly and the procedures for its Installation, Commissioning and Maintenance in the ST700 Cabinet Assembly and other Cabinets. Also provided is guidance on testing and maintenance procedures.

1.2 SCOPE OF THE HANDBOOK

This handbook is written for the ST700 and is made up of the sections listed below.

Section 1 Introduction

Section 2 Specification

Section 3 Pedestrian Facilities

Section 4 Hardware Overview

Section 5 Installation and Commissioning Procedure

Section 6 Routine Maintenance Procedures

Section 7 Self-Test Facility

Section 8 Handbook Omissions/Personal Notes

Section 9 Fault Information Form

Appendix A Part Numbers and Spares List

Appendix B Drawings

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1.3 RELATED DOCUMENTS

The following is essential for anyone undertaking first line maintenance on the ST700:

667/HH/27000/000 ST800/ST700 CONTROLLER HANDSET HANDBOOK

This provides details of how to access the handset port through which the user communicates with the ST700.

The following documents may also be useful, particularly if other equipment is being used.

667/HE/20663/000	DETECTOR INFORMATION HANDBOOK
667/HE/20664/000	GENERAL TESTING HANDBOOK
667/HE/20665/000	ABOVE GROUND DETECTORS HANDBOOK
667/DJ/27000/000	ST800/ST700 FORMS HANDBOOK
667/HB/27000/000	ST800 GENERAL HANDBOOK

1.4 ISSUE STATE

Pages	Current Issue	Type	Part ID
1 to 100	5	Meridian	667/HB/27880/000

1.5 DEFINITIONS

Cabinet Assembly	The ST700 Rack Assembly installed in the ST700 Cabinet with associated equipment mounting frame, mounting stool, mains distribution, power supplies, electronic control and phase switching.
Configuration data (also referred to as customer's data) and site specification	Data supplied by customer as to how the ST700 is to function. It is recommended that the forms in the Siemens ST800/ST700 Forms Handbook (see Section 1.3) be used as the blank for this purpose.
EM	Controller identification number (ElectroMatic).
Firmware EPROM	This goes on the Main Processor Board.
Pedestrian grouping	A group of Red, Amber and Green traffic signals plus their associated Red Man, Green Man and Waits of the pedestrian signals.
Rack Assembly	This consists of a box like frame with a plate hinge on the front that acts as an access door. The Phase Drive PCB and PSU are mounted behind the ST700 CPU PCB.
STS (Site to Scale)	This is a scale drawing of the intersection including Cabinet Assembly position, detector loop positions and specification, cable routing and poles with signal head arrangements.
TR0141C	DETR Specification

Works Specification	Document produced by Siemens, which details the hardware required for the ST700 and includes Site Data, usually in the form of a printout of the data entered on the configurator.

1.6 ABBREVIATIONS

AC	Alternating Current
AGD	Above Ground Detector
BIT	Binary digit (i.e. `0' or `1')
CET	Cable Earth Terminal
CLF	Cableless Linking Facility
CPU	Central Processing Unit
DC	Direct Current
DFM	Detector Fault Monitor
ELV	Extra Low Voltage
EPROM	Erasable Programmable Read Only Memory
FT	Fixed Time
IC	Integrated Circuit
IC4	ST800 Configurator
I/O	Input/Output
I/P	Input
LED	Light Emitting Diode
LV	Low Voltage
mS	milliseconds
OMU	Outstation Monitor Unit
OTU	Outstation Transmission Unit
PCB	Printed Circuit board
PLD	Programmable Logic Device
PROM	Programmable Read Only Memory
PSU	Power Supply Unit
RAM	Random Access Memory
RCD	Residual Current Device
RFL	Reset Fault Log (handset command)
RMS	Root Mean Square
ROW	Right Of Way
RTC	Real Time Clock
SA	Speed Assessment
SDE	Speed Discrimination Equipment
ST	Self Tuning
UTC	Urban Traffic Control
VA	Vehicle Actuated

1.7 RECOMMENDED TOOLS REQUIRED

It is recommended that the tools listed here should be acquired before attempting the installation or maintenance of an ST700 Rack Assembly or Cabinet Assembly.

Some cabinet doors require a special tool to release screwlocks at the top and bottom corners. Note that the key lock should be opened before the screwlocks to aid operation, and vice versa when closing the cabinet.

TITLE	PART NUMBER
'T'-KEY Screwlock	667/2/20234/000
Key - Yale 900 (manual panel door)	667/4/13651/000
Crimp tool	999/4/44083/000
Crimp removal tool	999/4/44082/000
Small Hammer	4/TL0003
Dusting Brush	4/TL0007
5mm Socket	4/TL0019
5.5mm Socket	4/TL0020
8mm Socket	4/TL0022
10mm Socket	4/TL0024
T-Bar	4/TL0025
8" Extension	4/TL0026
Centre Punch	4/TL0027
Mole Grips	4/TL0028
Junior Hacksaw	4/TL0029
Soldering Iron	4/TL0038
No.1 Pozi Screwdriver (Insulated)	4/TL0041
No.2 Pozi Screwdriver (Insulated)	4/TL0042
No.3 Pozi Screwdriver (Insulated)	
Phoenix Screwdriver	Phoenix SZS 0.4 x 2,5
Terminal Screwdriver (Insulated)	4/TL0044
Electrical Screwdriver (Insulated)	4/TL0045
10” Screwdriver	4/TL0047
Electrician's Pliers	4/TL0050
Side Cutters	4/TL0051
Snipe Nose Pliers	4/TL0053
7mm Socket	4/TL0069
6" Screwdriver (Insulated)	4/TL0085
Small Side Cutters	4/TL0086
Lump Hammer	4/TL0087
Tool Box	4/TL0089
Stanley Knife	4/TL0091
Crow Bar	4/TL0092
Jokari Knife	4/TL0095
Hacksaw	4/TL0096
Ring Spanner, 5/8 X 3/8	4/TL0098
Scissors	4/TL0114
Spirit Level	4/TL0129
7mm Combination or Open ended Spanner	
8mm Combination or Open ended Spanner	

10mm Combination or Open ended Spanner	
17mm Combination or Open ended Spanner	4/TL0133
Wire Strippers	4/TL0142
Portable Gas Soldering Iron	4/TL0144
Tool Belt	4/TL0153
Tool Case	4/TL0154
RIVET GUN (suitable for M4 Rivets)	4/TL0219
No.1 Pozi Screwdriver 10" long	4/TL0231
Hose Clip Driver	4/TL0318
IC insertion/extractor tool.	4/ST1244
17mm Socket, extension and driver	
Socket Set 1/4" drive (Typically BH04-2420)	

Gasket (To seal Manual Panel to Lid)	667/7/27129/000
Sealant (To seal Stool to equipment mounting frame)	996/4/05032/003
Base sealant PX212ZF	992/4/00216/000

2. SPECIFICATION

The Specification that follows is for the ST700 Cabinet Assembly. Where appropriate it also applies to the ST700 Rack Assembly as supplied for installation in another Cabinet.

Export specifications are detailed where they differ from standard UK specifications.

2.1 EQUIPMENT INTRODUCTION

The ST700 is a Pedestrian Controller and Small Export Traffic Controller.

It can be supplied as

- Single Pedestrian controller (2 Phase)
- Dual Pedestrian Controller (4 Phase)
- Small Export Controller (6 Phase)

When the ST700 is supplied without an outercase it is known as the ST700 Rack Assembly.

Generally it comes as a fully fitted Cabinet Assembly with its own equipment mounting frame, mounting stool, mains distribution, power supplies, electronic control and phase switching. It is then known as the ST700 Cabinet Assembly. This ST700 Cabinet Assembly can also accommodate Detectors, I/O PCB, OTU PCB, an OMU Assembly, Manual Panel, Master Switch Assembly and a Dimming Transformer.

The ST700 Cabinet is ground mounted and small in size, it has front, sides and top access when the Cabinet lid is removed.

It may also be fitted as a “Cuckoo” into many existing cabinets, when supplied as a Rack Assembly consisting of the power/phase assembly and a CPU. There are a number of conversion kits available that enable it to be installed into other cabinets.

The ST700’s electronics consist of three PCBs:

- The CPU PCB that contains most of the logic, which controls the system and the extra low voltage inputs and outputs, i.e. detector inputs, audible outputs, etc.
- The Phase Drive PCB that contains most of the Mains distributions, the triac phase drive outputs, voltage and current monitoring.
- The PSU (24V) that provides the main power supply for the ST700.

The CPU PCB operates under the control of both a main and a secondary processor. The main processor is a Motorola 68340, which runs the firmware controlling all the functions of the ST700’s operations. The secondary processor is an Intel 80C31 controlling all the phase output switching and voltage monitoring. The

two processors communicate with each other through shared RAM. This dual processing provides additional safety features, as each processor continually monitors the actions of the other, and independently turns off the lights to the motorists and pedestrians if either processor causes an error.

The software is written in a powerful high level language that allows the implementation of the ST700's extensive facilities. The ST700 offers both Single and Dual Pedestrian operation and up to a 6 Phase Traffic Controller operation, each with solid state switching.

The power/phase assembly with its associated Phase Drive PCB and PSU can drive up to 18 signal outputs with 230V at 4A. The pedestrian signals are configurable to supply either 230V or 48V. Each of the two pedestrian groupings has current monitoring on two separate vehicle approaches for Red, Amber and Green lamps plus one unmonitored approach Red lamp only. This provides TR0141C Red lamp monitoring for the Red lamps and lamp monitoring for the Amber and Green lamps.

It can be supplied as an ST700 Cabinet Assembly or as an ST700 Rack Assembly ready to be mounted in other cabinets. Mounting in other cabinets requires an addition conversion kit, and any of the ancillary equipment that may be required i.e. Detectors, OTU, etc.

2.1.1 Single Pedestrian Controller

The ST700 Single Pedestrian Controller consists of one vehicle phase and one pedestrian phase with a minimal set of I/O to perform all the functions of 2 phase Pelican, Puffin or Toucan. These consist of 32 buffered inputs, 8 isolated relay outputs, 2 Audible outputs and 1 Tactile Interlock output.

Expansion may be achieved by adding combinations of the following equipment:

- Inputs/Outputs PCB
  This board can expand the inputs/outputs as follows:
  16 Inputs
  16 Outputs

- Detectors
  These can be Siemens, Microsense or Sarasota self tuning units. Up to 4 units can be accommodated in the ST700 cabinet, each unit having four detector channels.

- Ancillary Equipment
  OTU – Outstation Transmission Unit for Tele Command 12.
  OMU – Outstation Monitoring Unit for Remote Monitoring System.

2.1.2 Dual Pedestrian Controller

The ST700 Dual Pedestrian Controller consists of 2 vehicle phases and 2 pedestrian phases with a minimal set of I/O to perform all the functions of 4 phase Pelican, Puffin or Toucan. These consist of 32 buffered inputs, 8 isolated relay outputs, 4 Audible outputs and 2 Tactile Interlock outputs.

2.1.3 Small Export Controller

The ST700 Small Export Controller consists of a 6 Phase Traffic Intersection Controller. It is similar to the Pedestrian controllers, except in the following areas:

- It has 6 Phases
- It has no built in current lamp monitoring facilities
- It cannot be configured to output 48V from any of its Phase Drive outputs.

2.1.4 Types of Pedestrian Controller

A number of different types of pedestrian crossings are available on the ST700. The following table lists the different types of 'stand-alone' pedestrian crossings detailed in TR0141C:

Type of Crossing	Ped. Signal Position	Pedestrian to Vehicle Clearance Period	On-Crossing Detectors	Kerbside Detectors
"Pelican"	Far-side	Vehicle Flashing Amber Pedestrian Flashing Green	No	No
"Puffin"	Near-side	Vehicle Red Pedestrian Red	Yes	Yes
"Pedestrian"	Far-side	Vehicle Red Pedestrian Blackout	Optional	No
"Toucan"	Far-side	Vehicle Red Pedestrian Blackout	Yes	No
"Toucan"	Near-side	Vehicle Red Pedestrian Red	Yes	Yes

These are described in more detail in sections 3.1.1 to 3.1.3 titled 'Pelican Crossing', 'Near Sided Pedestrian Crossing' (which covers both 'Puffin' and 'Toucan') and 'Far Sided Pedestrian Crossing' (which covers both 'Pedestrian' and 'Toucan').

The 'on-crossing detectors' are described in section 3.1.4, while 'kerbside detectors' are described in section 3.3.

2.2 BASIC SYSTEM OVERVIEW

Control	Main Microprocessor	Motorola 68340
	Firmware Storage	PROM (27C4002)
	Working Data Storage	Static RAM (256K) (Battery Backed)
	Secondary Microprocessor	Intel 80C32
	Firmware Storage	PROM (27C512)
	Working Data Storage	Internal to Microprocessor Device
	Inter-Processor Communications	Dual Port RAM 71321 (2K x 8)
	Hardware Fail Flash	Programmable Logic Device DIL Switches
Lamp Switching	Triac	Opto isolated, zero crossing No Load at dimming changeover
Conflict System	Main and Secondary Processors	Self Testing
Physical Hardware	CPU Card	PCB (244mm x 228mm)
	Phase Drive Card	PCB (253mm x 235mm)

2.3 MAINS SUPPLY

The following supply voltages may be used:

Nominal Voltage	Minimum Voltage	Maximum Voltage
100-240	85	264

It is recommended that the signals are supplied at the nominal mains voltage during Bright. I.e. For a 200V nominal supply, use 200V transformer/bulbs.

THE PROSPECTIVE SHORT CIRCUIT CURRENT OF THE SUPPLY MUST NOT EXCEED 16,000 AMPS

Frequency:	50Hz ±2Hz or 60Hz ±2Hz
Mains Brownout:	Continues operating with up to 50mS loss of mains.
Mains Fail:	Restarts without operator intervention.
Battery Support:	Primary cell Lithium battery provides support for the following during power failures. (a) Clock Synchronisation (programmable up to 31 days). (b) Timing Data (greater than one year). A large capacitor provides support for a minimum of 4 hours if the battery has failed or is removed for replacement.
Dimming Voltage:	120V, 140V, 160V RMS
Solar Cell Input:	Dimming cannot be provided at mains supplies below 200V. Solar input operating voltages are as follows: Bright to Dim > 80V RMS Dim to Bright < 40V RMS

The solar cell enables the ST700 to identify the light level and thus dim the signals when it is dark. The switch is set to operate at 55 lux and release at 110 lux. There is an optional time switch that can be used to regulate dimming control if required.

2.3.1 Electrical Noise

2.3.1.1 Supply Transients

The ST700 has been designed to withstand all the transients as defined in EN50295 on its supply.

2.3.1.2 Electrical Interference

The ST700 has been designed to create very little electrical interference, by the use of mains filters and solid state lamp switching control. The mains filters protect the incoming mains supply from any ST700 generated signals. The lamp switches are switched at zero crossover of the mains supply to reduce any switching transients.

The switching of the signals for dim/bright lamps changeover is controlled carefully to ensure the inductive switching does not cause interference.

The ST700 design is also extremely tolerant of externally generated electrical interference. Care is taken to avoid earth loops using a ‘Star’ point earthing system

to which the cabinet, the internal metalwork, the junction cabling and the mains earth is connected.

The arrangement and partitioning of the equipment is carefully organised to reduce electrical noise.

The PCBs have two inner layer planes used for noise reduction. One is connected to zero voltage and the other connected to +5V, to form a complete screen with extensive capacitive de-coupling across the planes, which form the logic supplies. Unused inputs are connected to the logic supplies to ensure their logic state.

The phase switching (signal outputs) system has isolation provided by Opto-SCRs and zero crossing switched Triacs, for the mains switching. The circuit includes a snubber filter circuit that aids triac switch off and reduces noise when an inductive circuit is connected.

2.4 DETERMINATION OF LOADING AND POWER CONSUMPTION

Described below are the methods used to determine:

- how the ST700 supplies the total lamp load required
- the overall power used and thus estimate site running costs.

2.4.1 ST700 Load

The typical supply requirements for an ST700 are:

• 40 watts	Single (2 Phase) or Dual (4 Phase) Pedestrian Controller
• 50 watts	Export Controller (6 Phase)
• 2.4 watts per unit	Siemens ST4R detectors
• 3 watts per unit	Sarasota MTS36Z (2 channel) or MTS38Z (4 channel) detectors. (NB The power consumption is the same for both 2 and 4 channel units.)
• 6 watts per unit	Microsense detectors

These requirements exclude lamp loads, detectors and OTU but include dimming transformer.

2.4.2 Lamp Drive Capability

	Amps	Max Power (Watts)	No. of Lamps Halogen (See Note 1)	L.E.D. (See Note 5)
Maximum lamp current that the ST700 can supply including short-term illumination, i.e. red/amber.	8A	1840W	29 on 230V (See Note 2)	65
Maximum lamp load for each triac output on the phase drive PCB.	4A @ 230V or 4A @ 48V	920W or 192W	14 on 230V or 4 (Waits) on 48V (See Notes 3 & 4)	32 or 48 LED Waits or 10 AGD920/ 922

Note 1: The Lamp and Wattage columns are equivalents for the currents shown, based on a 230V supply.

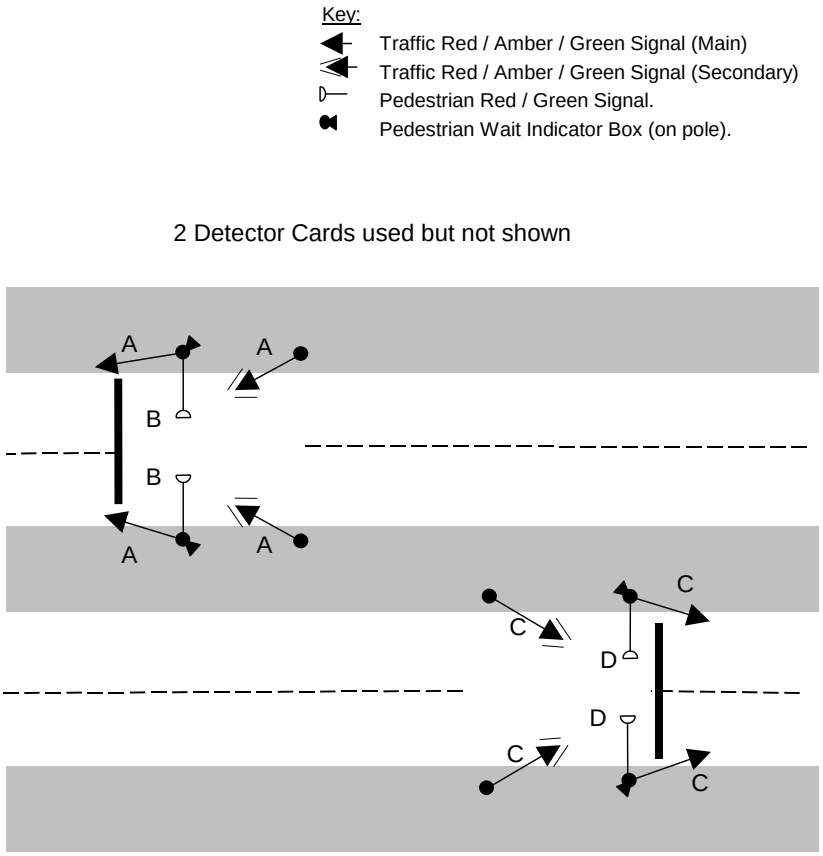
Note 2: For each lamp driven at 48V, subtract 1 from the total number of HI lamps at 230V.

Note 3: The Wait Lamps are based on 40W Lamps. (The limit is 4 x 40W or 3 x 65W Waits.)

Note 4: The Pedestrian Red, Green and Waits can be selected to provide 48V if a 48V Dimming Transformer is fitted.

Note 5: L.E.D. Signal Aspects can only be driven by 230V (and any associated Dim Voltage).

Figure 1 –Theoretical Crossing



Calculate the total average signal lamp power as follows, using the bright figures in the table.

Total average signal lamp power is the sum of the signal lamp power plus the sum of the Wait indicator power. Assuming that HI lamps take 63W each, the theoretical crossing (Figure 1) calculation would be:

One lamp per signal head @ 63W x 12 signal heads	=	756W
Wait indicators at 40W x 4	=	160W
Total average signal lamp power	=	**916W**

Table 1 – Calculate Total Average Signal Lamp Power

2.4.3 Calculation of an Intersection's Power Requirements for Running Costs Estimate

The following worked example is based upon a 230V/240V mains supply.

1. Calculate the total average lamp power for the junction as shown in Table 1.
2. Add the total average signal lamp power to the total average controller power:

Total average controller power is calculated as follows:

Average Controller power + Average Detector Power. See section 2.4.1.

A controller is rated at 40 watts (single or dual Pedestrian Controller).
For the purposes of this calculation Siemens ST4R detector cards are rated at 3W per card.

This gives the total average junction power, which may be used to estimate running costs.

i.e. Total average junction power = Total average signal lamp power + Total average controller power.

Therefore for our theoretical crossing (Figure 1) the total average controller power is:

1 x Controller	40 W
2 x Siemens ST detectors	6 W
Total average controller power	**46 W**

Table 2 – Calculate Total Average Controller Power

Note: The controller power should also include any additional equipment supplied by the controller. This may include, for example, OTU, OMU or Auxiliary detector power supply.

For the total average junction power to aid with running cost estimates, the total average lamp power must be added to the total average controller power.

Total average junction power is calculated as follows:

Total average lamp power	916 W
Total average controller power	46 W
Total average junction power	**962 W**

Table 3 – Calculate Total Average Junction Power

If an estimate of running costs is required that includes the period of time that the signals are dimmed, this can be approximated as follows:

Total average Junction Power (Dimmed) is:

Total average Signal Power x (Dimmed Voltage / Nominal Mains voltage) plus Total average Controller Power.

Therefore for the theoretical crossing in Figure 1:

Total average Junction Power (Dimmed)

= (916W x (160V/240V)) + 46W
= **657 W**

2.4.4 Detector Power Supplies

The maximum current available for detectors on the ST700 is 0.6A at 24V DC. Refer to the Detector Handbooks for power consumption of detectors.

If more current is required, then power all detectors from a 24V AC Detector PSU. See Appendix A for part number. This PSU provides a maximum of 2A at 24V AC and is in the form of a transformer that can be mounted in three different positions:

- On the side of the Detector chassis using the four appropriate fixing holes
- On the back of the metal outer case frame near the mount position of the detector chassis, using the four appropriate fixing holes.
- On the left-hand side flange of the metal outer case frame just above the Master Switch Panel, using the four appropriate fixing holes.

2.4.5 Audible and Tactile Supplies

The Audible and Tactile power supplies on the ST700 are designed to provide a DC voltage between 10V and 24V, and typically provide a maximum of 100mA at 18V DC.

The ST700 provides three audible outputs on each of the 2 pedestrian phases. These are located on the CPU card PL2 (Phase D) and PL3 (Phase B).

Pin 11 is titled ‘Tactile Phase n’ – This is intended to interlock a tactile unit via the tactile PSU ‘interlock’ input to prevent operation on a Pelican during the flashing green man period where the ‘Loud’ output is configured to be time-switched.

Pin 12 is titled ‘Audible Phase n Loud’ – This is the normal connections to audibles. This output can be configured to be time-switched. If the tactile is also required to be switched then the tactile PSU ‘interlock’ input signal can be taken from this output.

Pin 13 is titled ‘Audible Phase n Quiet’ - This output is for the secondary physically muted audible.

Audible and Tactile units used must operate correctly over the voltage range 10 to 24V DC.
The units recommended and supplied by STCL that meet this requirement are:

Audible:	667/4/04785/000 Highland Electronics type SC628P (previously Sonalert Mallory SC628P) Roxborough type SPCI535A4
Tactile:	667/7/17390/000 PELICAN currently Radix RS250 or RS252 667/7/17390/001 INTERSECTION currently Radix RS251 or RS252

NOTE – There are four main situations for audible/tactile control that arise on an ST700. These are –

1. Normal Audibles – The 'Loud' output is used.
2. Switched Audibles – The 'Loud' output can be used configured to switch off at selected times (e.g. at night). If the Tactiles are also to be switched then the tactile PSU 'interlock' input can be connected to this output.
3. A Muted Audible Output – The 'Quiet' output can be connected to the second audible. This audible will require a local physical muting method.
4. A Pelican With Flashing Green Man – The 'Loud' output is off during the flashing period. Thus the 'Loud' output is used to connect to the audibles and the tactile PSU 'interlock' signal input. If the 'Loud' output is configured to be time switched, then the 'Tactile' output is used to control the tactile PSU interlock signal input.

2.5 PHASES

The ST700 Pedestrian Controller supports either 2 'Real' Phases for a single pedestrian crossing or 4 'Real' Phases for a dual pedestrian crossing.

The ST700 Export Controller can support up to 6 'Real' Phases.

The ST700 software can support up 32 phases, which can be any combination of real and software phases.

2.6 STAGES

The ST700 software supports up 32 stages. Note that Stage 0 is normally ALL RED.

2.7 TIMINGS

All ST700 timings are transferred to battery supported RAM during initialisation. Once in RAM, most timings can be varied by handset commands. Once the configuration data has been loaded into the ST700, the same configuration cannot be loaded again. This prevents the accidental overwriting of any configuration data that may have been set up using the handset.

In the UK some timings considered to be fixed timings cannot be changed by handset. These are typically the Amber and Red/Amber periods. These timings can, however, be specified as alterable at configuration time to suit other signal sequences, export requirements etc.

Some timings considered to be safety timings can only be changed by a person at the ST700 operating the write enable 'level 3' push button, e.g. minimum green, intergreen, blackout timings, etc.

The default timings for the ST700 standard Pedestrian configurations are given in their IC4 printouts (Special Instructions). These printouts also show the handset

commands that are used to change each of the timings. Some of these timings are described in Section 3.

A summary of all the timings available within the ST700 export intersection controller is contained in the ST800 General Handbook (see Section 1.3 for details). It also shows their upper and lower limit values and, where applicable, the configurable limits.

2.7.1 Tolerance

All timings, except CLF and Master Time Clock, are derived from the crystal frequency which has a tolerance of 35 parts per million. An additional error, due to random signals not being synchronised to the clock pulse, may add up to 200ms to the time.

If the result of the above timings is required to change the signal lamps, a further error may occur up to a maximum of 21ms.

The set-up accuracy of the real time clock and the accuracy of any offsets calculated from it will be 1 second.

2.8 MASTER TIME CLOCK AND CLF SUMMARY

- Master Time Clock
- Timing Sources – 50Hz or 60Hz Mains (automatically detected)
- Standby Timing – On board crystal and battery support programmable up to 31 days. Accuracy of standby crystal oscillator is 35 parts per million.
- Programmable changeover to mains synchronisation.
- Facility for synchronising the real time clock or group timer from existing UTC.
- Number of time switch settings – 64
- Number of time switch functions – 3
  - (a) Isolate controller
  - (b) Introduce a CLF plan
  - (c) Introduce time-switch events such as alternative maximum green periods
- Cableless Link Facility
  - Number of plans: 16
  - Number of plan influence tables: 16
  - Number of groups per plan: 32
  - Number of group influences: 10 types

2.9 MODES OF OPERATION

The following modes are available on the ST700 Pedestrian controller, and are described fully in Section 3:

- Pelican V.A.
- Pelican V.A. with pre-timed maximum period
- Pelican Fixed Vehicle Period
- Pelican Cableless Link (Pedestrian inhibit)
- Pelican UTC ('PV' control bit)
- Pelican Local Link ('PV1' control)

The following intersection modes are available on the ST700 Export controller:

- Start Up
- Part-time (Off period)
- Urban Traffic Control.
- Emergency Vehicle
- Priority (Non-emergency vehicle)
- Hurry Call
- Manual Operation
- Manual Step-On, if fitted.
- VA, CLF or FT Operation (selected via mode switch)
- Cableless Linking
- Vehicle Actuated (VA)
- Fixed Time (FT)

2.10 CABINET CHARACTERISTICS

The ST700 Cabinet Assembly has all round access, with the Lid (which consists of the top and all four sides of the cabinet) removed. It has the following dimensions:

Height (above ground level)	982mm
Width	375mm
Depth	255mm
Approximate weight of ST700 Cabinet Assembly only (Incl. Lid)	32kg
Approximate weight of ST700 Lid only	8kg

Table 4 – ST700 Cabinet Assembly Size and Weight

The Cabinet Assembly Lid is manufactured in aluminium and finished with grey Polyester Powder Coat paint.

The Lid is secured on the ST700 Cabinet Assembly with a single screw-lock mechanism.

The lock used on the Police manual panel is a small Yale lock with a 900-pattern barrel.

2.11 ENVIRONMENTAL

2.11.1 Temperature

The ST700 in a grey outercase is designed to operate in external ambient temperatures of –25ºC to +60ºC.

Its use in countries where high levels of solar radiation are expected with longer periods of exposure may impose power restrictions on the ST700 hardware configuration. Contact Engineering at Poole for more details on hardware restrictions.

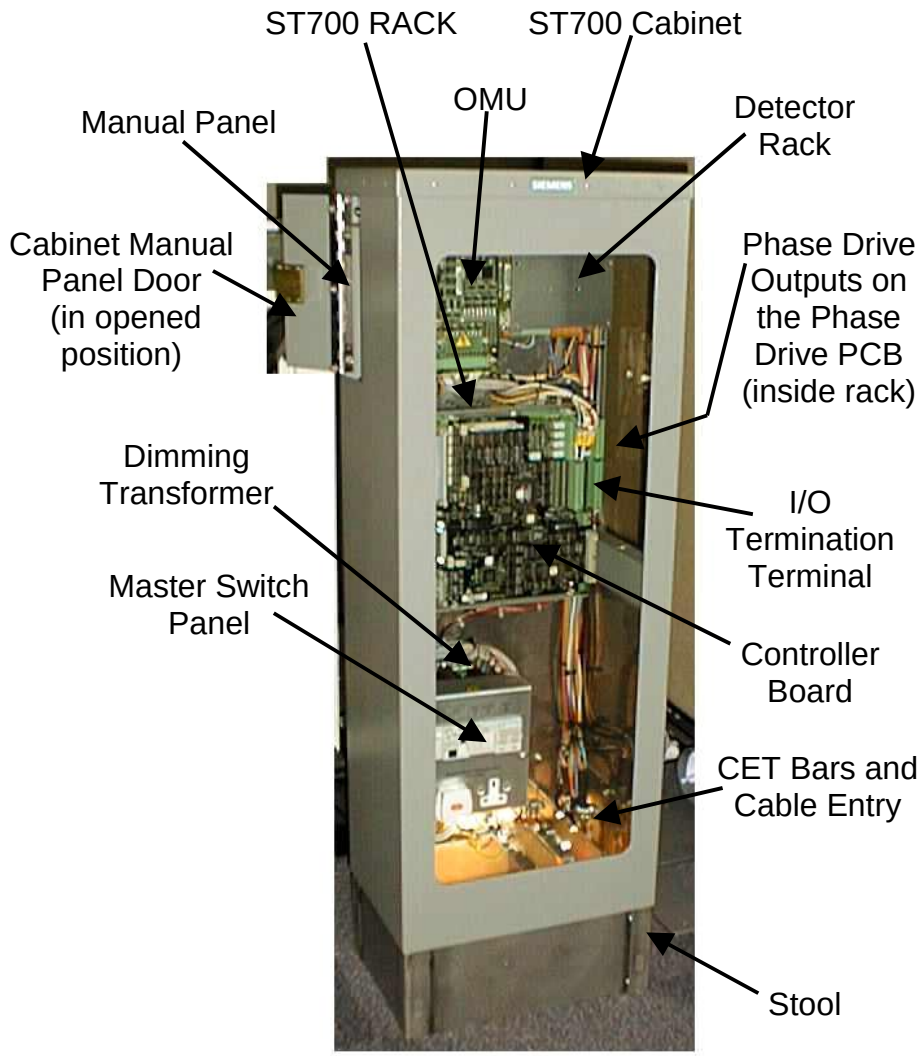
2.11.2 Atmospheric

The ST700 Cabinet Assembly is proofed against driving rain and industrial pollution.

2.11.3 Humidity

The ST700 will withstand a temperature of 45°C with a relative humidity of 95%.

Figure 2 –ST700 Cabinet Assembly



FRONT VIEW OF CABINET
(with front cut out in the cabinet)

2.12 HANDSET INTERFACE (RS232 PORT)

Type

RS232C CCITT V24 and V28

Method of Connection

Controller	-	Cannon DP 25-way socket connector
Terminal Device	-	Cannon DP 25-way plug connector

Pin Allocation

Pin 1	-	Protective ground
Pin 2	-	Transmit data from terminal to controller
Pin 3	-	Received data from controller to terminal
Pin 4	-	Request to send
Pin 5	-	Clear to send
Pin 6	-	Data set ready
Pin 7	-	Signal ground
Pin 9	}	5V supply (controller 5 volt logic/user supply)
Pin 10	}	
Pin 18	]	Ground supply
Pin 19	]	
Pin 20	-	Data terminal ready

Bit Format

START	1	2	3	4	5	6	7	PARITY	STOP
(SINGLE BIT)	(LSB	•	•	•	•	•	MSB)	(EVEN)	(SINGLE BIT)

Baud Rate

1200 Baud

Mode

Full duplex

Character Set

ISO Alphabet No. 5 (ASCII)

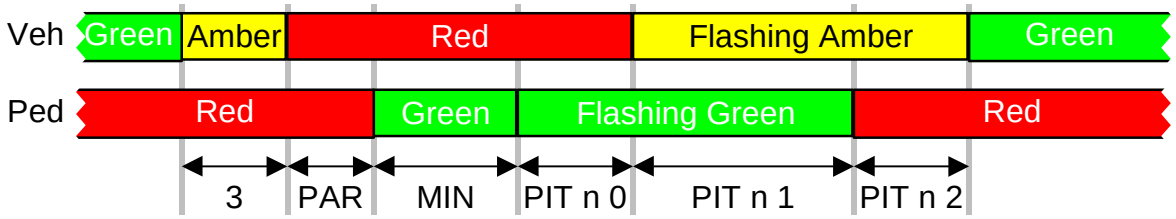
3. PEDESTRIAN FACILITIES

3.1 TYPES OF PEDESTRIAN CROSSINGS

3.1.1 Pelican Crossing

The vehicle to pedestrian intergreen is controlled by the PAR Pedestrian All-Red period. The PAR handset command allows different all-red periods to be executed depending on why the vehicle phase left green. Different times can be specified for each of the following: fixed vehicle period mode (see section 3.2.1), VA mode 'gap' change and VA mode 'max' change (see section 3.2.2), a 'linked' change (see section 3.2.4).

The pedestrian to vehicle intergreen is divided into three fixed periods governed by the PIT Pelican Intergreen Times.



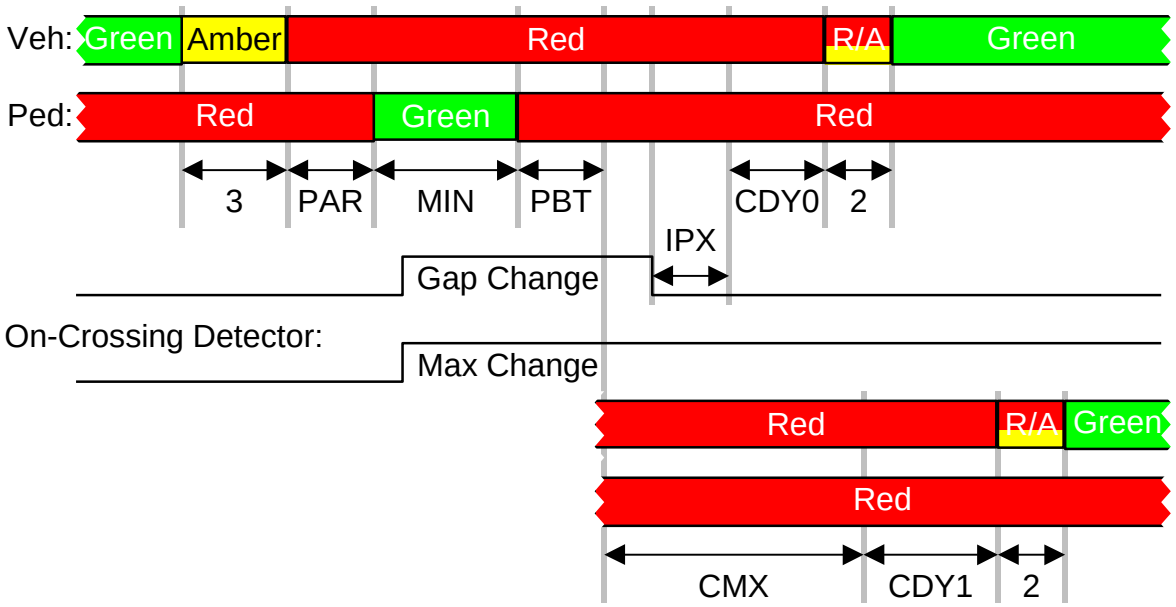
3.1.2 Near Sided Pedestrian Crossing

The vehicle to pedestrian intergreen on a stand-alone crossing is controlled by PAR. However if the near-sided pedestrian phase is part of an intersection stream, then this period is controlled solely by the IGN intergreen command.

The pedestrian to vehicle clearance period consists of:

- a minimum period governed by PBT p,
- an extendable period limited to a maximum governed by CMX p,
- a gap clearance delay CDY p 0, or
- a max clearance delay CDY p 1

where 'p' is the pedestrian phase letter.



On intersections, the appearance of the vehicle phase will be delayed further if the IGN intergreen time is larger than PBT plus the red/amber period.

3.1.3 Far Sided Pedestrian Crossing

The vehicle to pedestrian intergreen on a stand-alone crossing is controlled by PAR. However if the far-sided pedestrian phase is part of an intersection stream, then this period is controlled solely by the IGN intergreen command.

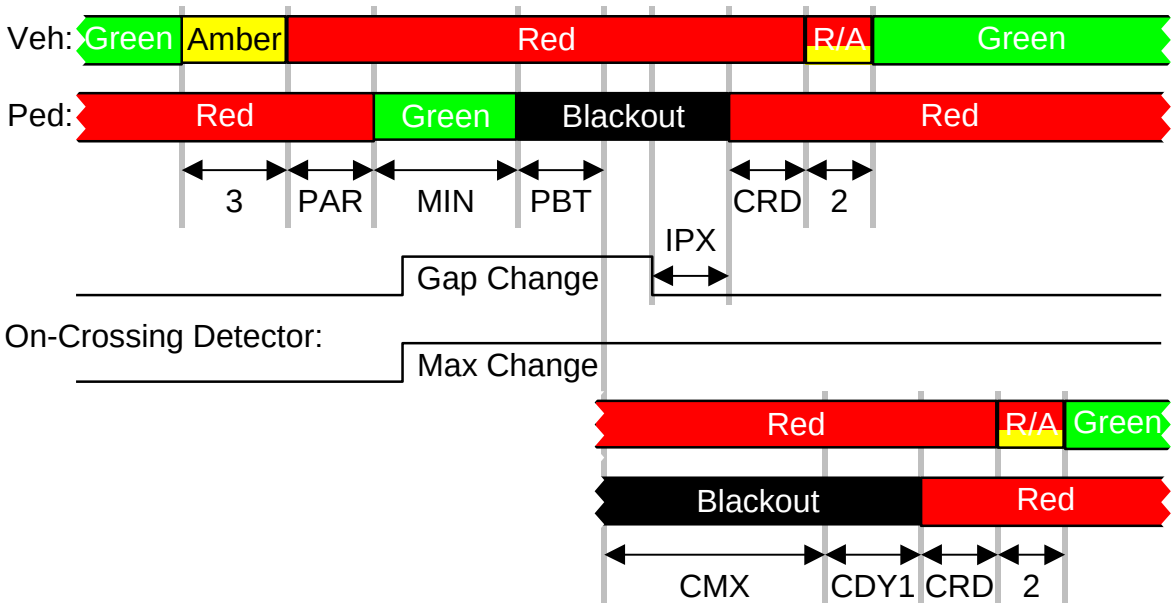
The pedestrian to vehicle blackout clearance period consists of:

- a minimum period governed by PBT p,
- an extendable period limited to a maximum governed by CMX p,
- a gap clearance delay CDY p 0*, or
- a max clearance delay CDY p 1

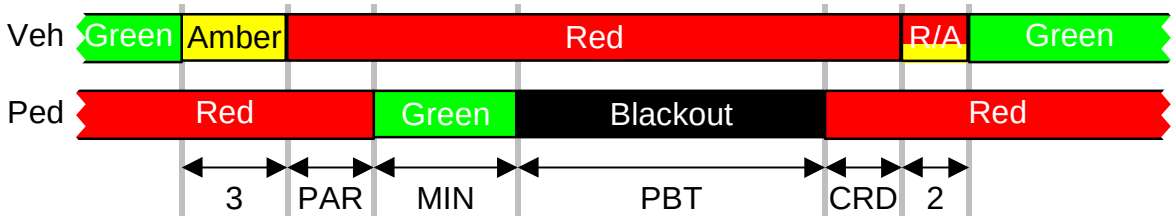
where ‘p’ is the pedestrian phase letter.

Following this blackout clearance period, there is a clearance all-red period CRD p.

0 The gap clearance delay CDY p 0 is usually set to zero and hence is not shown on the following diagram.



If a fixed black-out period is required, i.e. with no on-crossing detectors, then CMX should be set to zero so that the black-out period is controlled solely by PBT:



On intersections, the appearance of the vehicle phase will be delayed further if the IGN intergreen time is larger than PBT plus CRD plus the red/amber period whether CMX is zero or non-zero. But for backwards compatibility, if CMX and CRD are both zero, then the intergreen is controlled solely by IGN even if PBT is set longer.

3.1.4 On-Crossing Detectors

'On-Crossing Detectors' are above ground detectors that are used to determine whether pedestrians are still crossing. While pedestrians are still crossing, the extendable clearance period is extended, up to its configured maximum (CMX in the above diagrams).

The on-crossing detector inputs are configured using a new screen on IC4, similar to the VA demand/extension screen, and the extension times are configured on an input basis (i.e. IPX).

If an on-crossing detector is unused, i.e. where several have been configured by default on a stand-alone controller, it can be de-allocated using IOA. If no extendable clearance period is required on a particular phase, then the clearance maximum time (CMX) can be set to zero. If all of the on-crossing detectors for a phase are de-

allocated but the clearance maximum time is non-zero, then the clearance period is extended up to its maximum.

Also note that if the Continuous Ped Demand (CPD) button on the manual is pressed, then the red clearance of near-sided signals will be extended to its maximum as required by TR0141C.

If an on-crossing detector has not been activated from the end of the preceding pedestrian clearance period to the end of the current pedestrian steady green period, then the clearance period is forced to run to its maximum.

A fault will not be recorded if this occurs, instead the controller will wait until the normal DFM time-outs confirm and report a fault.

3.2 PEDESTRIAN MODES OF OPERATION

A stand-alone pedestrian crossing can run any of the following modes of operation:

3.2.1 Fixed Vehicle Period

The vehicle phase appears at green for at least a fixed period. No vehicle detection equipment is required.

If the pedestrian phase is demanded while this period is still running, the vehicle phase remains at green. When the period expires, the vehicle phase loses right of way and the pedestrian phase subsequently appears at green.

If the pedestrian phase is demanded after this fixed vehicle period has expired, then the vehicle phase immediately (subject to the pedestrian demand delay see section 3.3.3) loses right of way and the pedestrian phase subsequently appears at green.

When the pedestrian phase has completed its green period and the controller has executed the required ‘pedestrian to vehicle clearance period’ (see section 3.1), the vehicle phase returns to green.

The fixed vehicle period is specified by the handset commands MEX, MFX, MGX and MHX allowing four different times to be called up at different times of the week.

3.2.2 Vehicle Actuated

This mode requires vehicle detection equipment, either inductive loops cut into the road’s surface or ‘above ground’ detectors (usually microwave detectors) mounted on the signal poles. Activations on these inputs start (or restart) the ‘extension time’ for the phase and while this is active, the vehicle phase will (normally) remain at green.

The vehicle phase appears at green for at least a minimum period specified by the MIN handset command.

If the pedestrian phase is demanded while this period is still running, the vehicle phase remains at green until at least this period has expired.

If the pedestrian phase is demanded after this ‘minimum’ period has expired and no vehicles are present, then the vehicle phase loses right of way immediately.

If the vehicle detectors indicate that vehicles are present, then the vehicle phase will remain at green until the vehicles are no longer present. This is referred to as a ‘gap change’ since the vehicle phase loses right of way to service the pedestrian demand when a gap in the traffic appears.

However, when the pedestrian phase is demanded, the vehicle phase’s ‘maximum green timer’ is started. If vehicles continue to be present, keeping the vehicle phase at green, the vehicle phase will lose right of way when this timer expires, even if vehicles are still present. This is referred to as a ‘max change’ since the vehicle phase loses right of way when its maximum green time expires.

The maximum green time is specified by the handset commands MAX, MBX, MCX and MDX allowing four different times to be called up at different times of the week.

When the pedestrian phase has completed its green period and the controller has executed the required ‘pedestrian to vehicle clearance period’ (see section 3.1), the vehicle phase returns to green.

3.2.3 Vehicle Actuated with Pre-Timed Maximum (PTM)

This mode is very similar to normal vehicle actuated mode, except that the vehicle phase’s maximum green timer is started as soon as the vehicle phase appears at green, regardless of whether there is a demand for the pedestrian phase.

The option is enabled using the PTM handset command.

Therefore, if the vehicle phase has already been at green for longer than its configured maximum green time when a push-button is pressed, the vehicle phase loses right of way immediately subject to the pedestrian demand delay (see section 3.3.3) or the pre-timed maximum extra period (see section 3.3.4).

Compare this to the normal vehicle actuated mode, where the pedestrian would have to wait for up to the maximum green time (if vehicles continue to be present) before the vehicle phase loses right of way.

3.2.4 Linked Operation

With the controller running any of the above three modes, the operation controller can be further modified by various 'linking' options.

These options hold the vehicle phase at green until a specific time when the pedestrian phase is allowed to appear. During this 'window' vehicle extensions are removed to ensure that any pending demand for the pedestrian phase is serviced.

This is often required, for example, when the pedestrian controller is close to an intersection where it is beneficial to keep the pedestrian controller at vehicle green during certain stages of the intersection controller to help the traffic entering and/or leaving the nearby intersection.

Cableless Link – Using the controller's Master Time Clock and CLF facilities, the controller can be given one or more 'windows' during the CLF cycle when it is allowed to service the pedestrian demands. For the rest of cycle, the vehicle phase remains at green.

UTC – The 'PV' control bit from the instation holds the vehicle phase at green. When the 'PV' bit is de-activated for a short period, the controller will service any pending demand for the pedestrian phase.

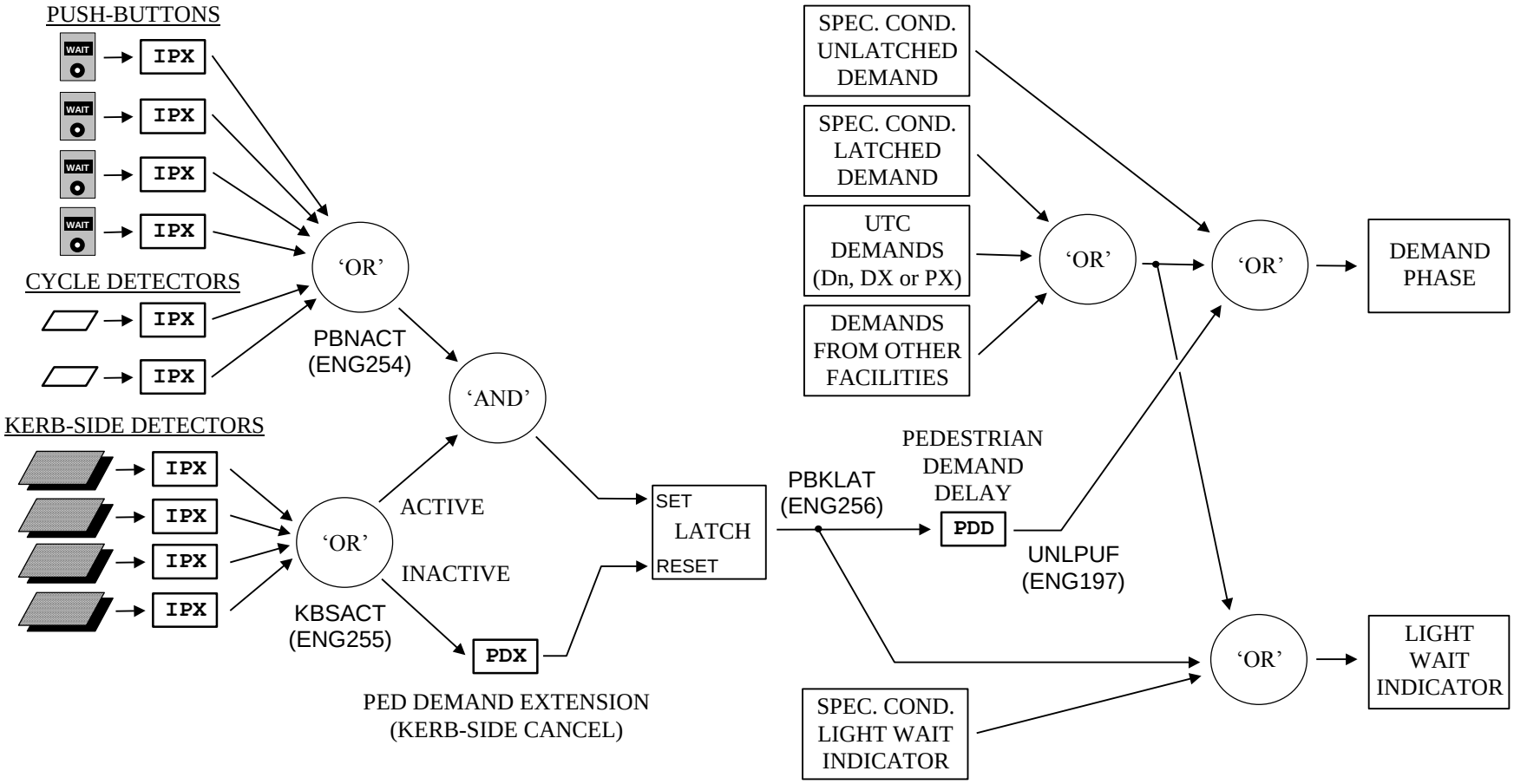
Local Link – The 'PV1' input from an adjacent controller holds the vehicle phase at green. When the 'PV1' bit is de-activated for a short period, the controller will service any pending demand for the pedestrian phase.

3.3 PEDESTRIAN DEMAND CONTROL

3.3.1 Introduction

In addition to pedestrian push buttons, the controller can be configured with 'kerbside detectors'. This allows the controller to cancel the demand (and switch off the wait indicator) if the pedestrian crosses before the pedestrian phase gains right of way.

Figure 3 – Ped Demand Processing



3.3.2 Pedestrian Demand Acceptance

If no kerbside detectors are configured, pressing the pushbuttons generates a latched demand for the pedestrian phase, which is only cleared when the pedestrian phase gains right of way.

If kerbside detectors are configured, then the operation is as follows:

Every pushbutton input, kerbside input and cycle detector input is configured with its own extension period specified by the IPX handset command. Each extension period remains active for the configured IPX period after the input returns to inactive.

When a pushbutton is pressed, the pushbutton extension period is started. Similarly, when a kerbside detector is operated, the kerbside extension period is started and when a cycle detector is operated, the cycle extension period is started.

A demand for the pedestrian phase is accepted and the wait indicator illuminated when a push button extension and a kerbside extension are both active at the same time. Also, a demand is accepted when a cycle extension and a kerbside extension are both active.

3.3.3 Pedestrian Demand Delay (PDD)

The transition from vehicle green to pedestrian green starts with the vehicle changing to amber. As required in, for example, section 6.2.1.1 of TR0141C, a delay can be configured before starting this transition so that the vehicle phase does not terminate as soon as the pedestrian push button is pressed, although the wait indicator is illuminated.

The delay is controlled using the handset command PDD.

The controller uses the following rules:

- In VA mode, if one or more real phases are at ROW and none of the phases at ROW have pre-timed maximums configured, then the delay is not applied, since if vehicles are present, their extensions keep the vehicle phase at green.
- In VA mode, the controller examines the maximum green timers of all conflicting phases which are at ROW which are also configured to run pre-timed maximums (but see section 3.3.4). If any have expired or have less time to run than the delay, then the delay is introduced, otherwise all have more time to run than the delay, so no delay is introduced and the controller will only allow the stage change if none of the phases are being extended.
- In VA mode, if no real phases in the same stream are at right of way, then the delay is introduced, so delaying the appearance of the pedestrian green after an all-red period.
- In all other modes, the delay is always introduced. This is to cater for cases such as ‘fixed vehicle period’ mode, UTC inserting a demand dependant

force for the pedestrian phase or CLF introducing a demand dependant move just after the push-button is pressed. Introducing the delay prevents these cases making a stage move shortly after the push-button is pressed. In most other cases, the demand delay has little or no effect.

Note that special conditioning can always be written to 'short-circuit' the pedestrian demand delay if required under certain circumstances by putting in an unlatched demand for the phase if the wait indicator is lit.

3.3.4 Pre-Timed Maximum Extra Period (PTX)

There is alternative facility to delay the termination of the vehicle phase for use with the vehicle actuated pre-timed maximum facility described in section 3.2.3.

If the pedestrian phase is demanded after the pre-timed maximum period has expired (or is close to expiring) the maximum green timer is re-started with a short 'extra' time period specified by the PTX handset command. Therefore, if vehicles are still present, the vehicle phase remains at green for up to this time. If no vehicles are present the vehicle phase loses right of way as soon as the push button is pressed (unlike PDD, which always applies its delay).

3.3.5 Pedestrian Demand Cancel (PDX)

The phase demand is cleared and the wait indicator is extinguished when all kerbside detectors and their extensions for the phase have been inactive for the configured pedestrian demand extension time for the phase (PDX). Note that the phase may still appear at green if the controller has already started the move to the stage in which the phase appears.

3.3.6 Kerbside Detector (Mat) Testing

Kerbside detector testing can be performed by the firmware to check the operation of kerbside 'mat' detectors.

Every 60 seconds, if there are no pedestrian phase demands active and no push-button (or cycle) inputs active, the controller outputs a 500ms (±50ms) test pulse on a configured output. If the output is de-allocated using IOA, then no kerbside testing will be performed.

This output is connected to all the kerbside detectors and should result in all of the kerbside inputs going active during the pulse.

Therefore, the test is not performed while a pedestrian demand exists since this will extend the pedestrian demand if the kerbside input has just gone inactive and the controller is timing off the kerbside and demand extension periods.

Nor is the test performed while any push-button or cycle inputs (or their extensions) are active since the kerbside test will activate the kerbside inputs even though no-

one may be present and allow these inputs to produce a demand for the pedestrian phase.

Each configured kerbside detector is sampled twice and if either sample on a particular kerbside detector indicates the detector is inactive[1], then the detector is logged as faulty, the DFM indicator is illuminated and the detector input forced active (regardless of the setting of the DFM forcing action command 'DFA').

Thereafter, the force is only removed after 5 consecutive tests of the detector have passed, but the fault log entry remains set and the DFM indicator remains illuminated, until RFL=1 is entered (as required by TR0141C).

This facility uses the normal DFM fault log flag (FLF 12) and fault log data (FLD 20 to 31) but will be clearly distinguishable in the historic rolling log. If a kerbside detector fails its tests, a fault is logged in the FLF/FLD fault log and in the rolling log as '`DFM L? KERBF`'. If it subsequently passes the kerbside test five times, then '`DFM L? KERBP`' is recorded. No more entries against this input will be recorded in the rolling log until the fault log is cleared using RFL=1 and '`DFM L? KERBC`' is recorded.

If it also fails the normal DFM check some time later, then the FLF/FLD fault log entries will not change, but a normal DFM entry such as '`DFM L95 IN12H`' will be added to the rolling log at this new time.

If ADF=1 is entered to accept DFM faults, then if either type of DFM fault has been logged against a kerbside detector, then this detector is accepted as being faulty and no longer goes towards illuminating the DFM indicator. The DFM indicator will not illuminate again if the other DFM test subsequently fails.

If the maintenance engineer enters RFL=1, the controller automatically performs a test. If a kerbside detector which was reported as faulty passes this test, even if this is the first test that it has passed, the fault log entry for that detector is cleared and the detector is assumed to be working. This means that when the maintenance engineer fixes a kerbside detector, they do not have to wait for 5 automatic tests before they can clear the fault, they just need to enter RFL=1.

If a kerbside detector input is de-allocated using IOA, the test is assumed to have passed. This caters for the case where an unused kerbside detector input fails the test, before the engineer sets IOA to 255 to de-allocate the input and then enters RFL=1 to clear the fault.

However, if the detector has failed normal DFM time-out stuck active or inactive, then it also needs a change of state of that input before the fault is cleared. Note that a detector that has failed stuck active naturally passes the kerbside detector test so this additional check is still required.

[1] Note that for the input to be seen inactive at the 200ms processing rate, all ten 20ms samples must have been inactive.

4. HARDWARE OVERVIEW

4.1 THE ST700 RACK ASSEMBLY

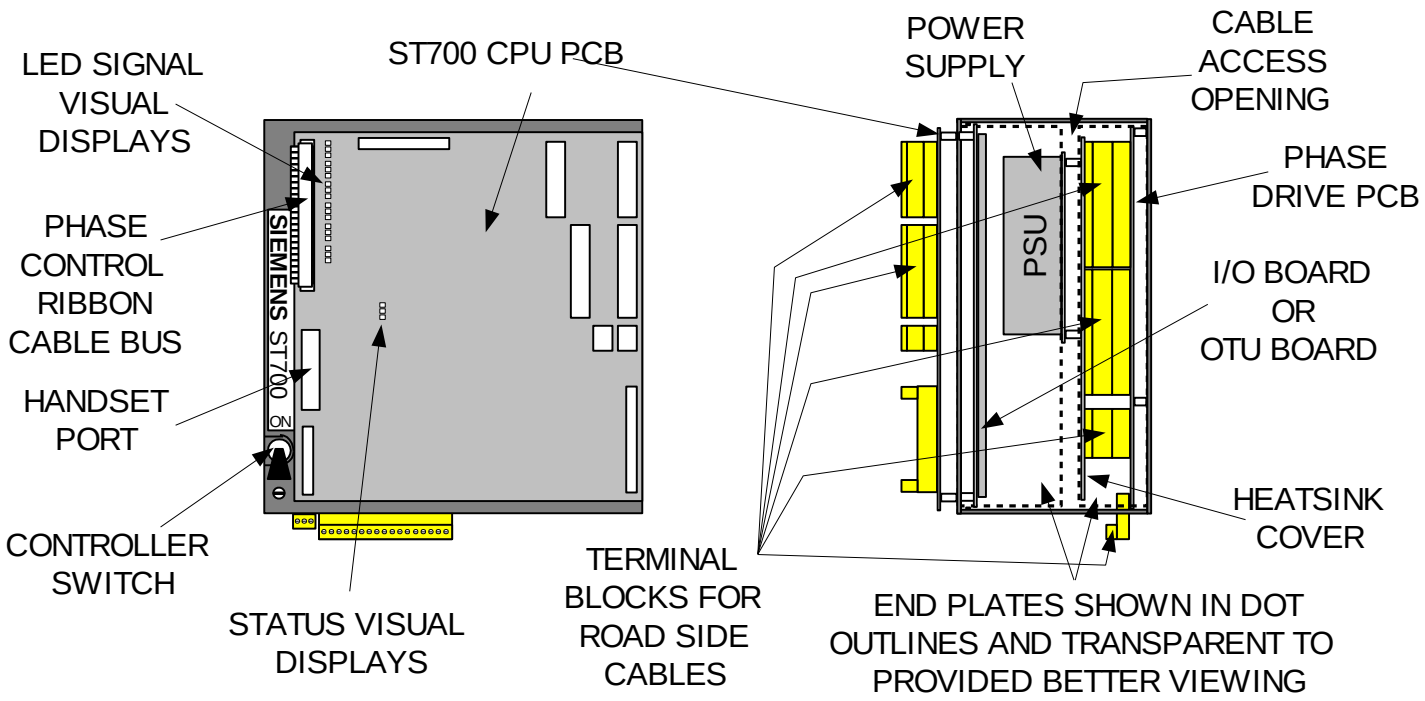


Figure 4 – ST700 Rack Assembly

The ST700 Rack Assembly consists of a box like frame with a plate hinge on the front that acts as an access door.

The Phase Drive PCB is mounted behind the ST700 CPU PCB in the Cabinet. This contains the logic power supply, the mains distribution, Solid State Relay, A Relay, B Relay, Dimming relays, the mains fusing, and the Phase Drives, along with the terminal blocks to wire the phase drives directly to the road side cables. The Phase Drive PCB has a flying 64-way Phase Control Bus ribbon cable attached. This connects to the ST700 CPU PCB and supplies the power and control signal to that card.

Mounted on the heatsink cover of the Phase Drive PCB is the mains power supply unit (24V DC output) that is mains powered from, and supplies 24Volts to, the Phase Drive PCB via a cableform.

The ST700 CPU PCB is mounted on the outside of the hinged plate. This contains the Dual Processors and associated logic, LED signals and status visual display, Handset Port, Modem Port, Manual Panel Port and I/O circuits along with the terminal blocks to wire the I/O circuits directly to the road side cables.

This leaves space on the inside of the hinged plate to mount an additional I/O PCB or OTU PCB as and when required. These cards are the same as those used on the ST800 and thus are connected to the ST700 CPU PCB using an extended system bus cable that runs along the side.

A pictorial view of the ST700 CPU PCB and Phase Drive PCB is given in Figure 4.

The photograph in Figure 5 shows the ST700 Rack Assembly mounted in an ST700 Cabinet, with a detector chassis and OMU mounted above it.

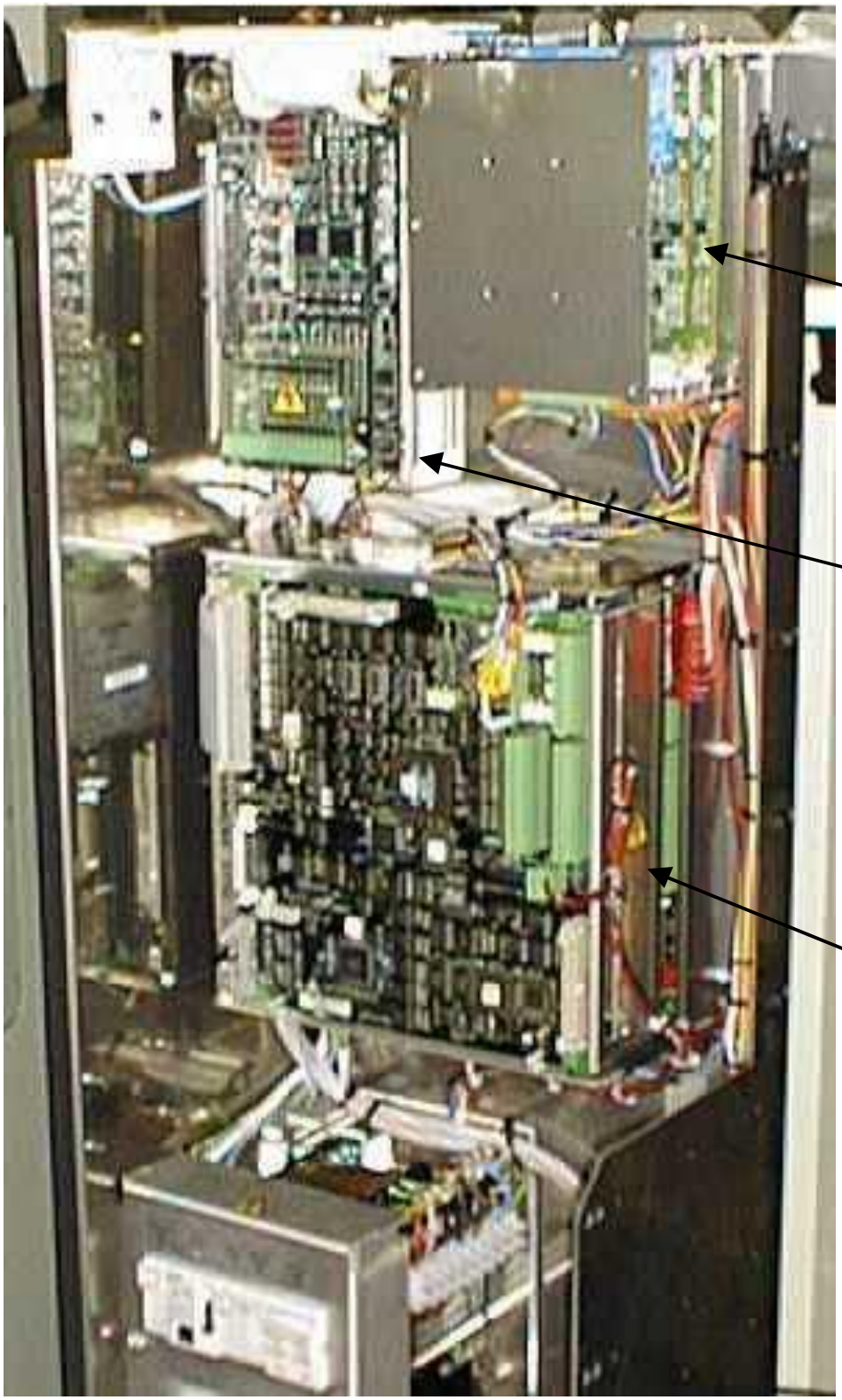


Figure 5 – ST700 Rack Assembly mounted in the ST700 Cabinet frame

4.2 ST700 CPU LEDS

There are 21 LED indicators on the component side of the ST700 CPU PCB in two groups, Status (see section 4.2.1) and Signal (see section 4.2.2), as shown in Figure 6.

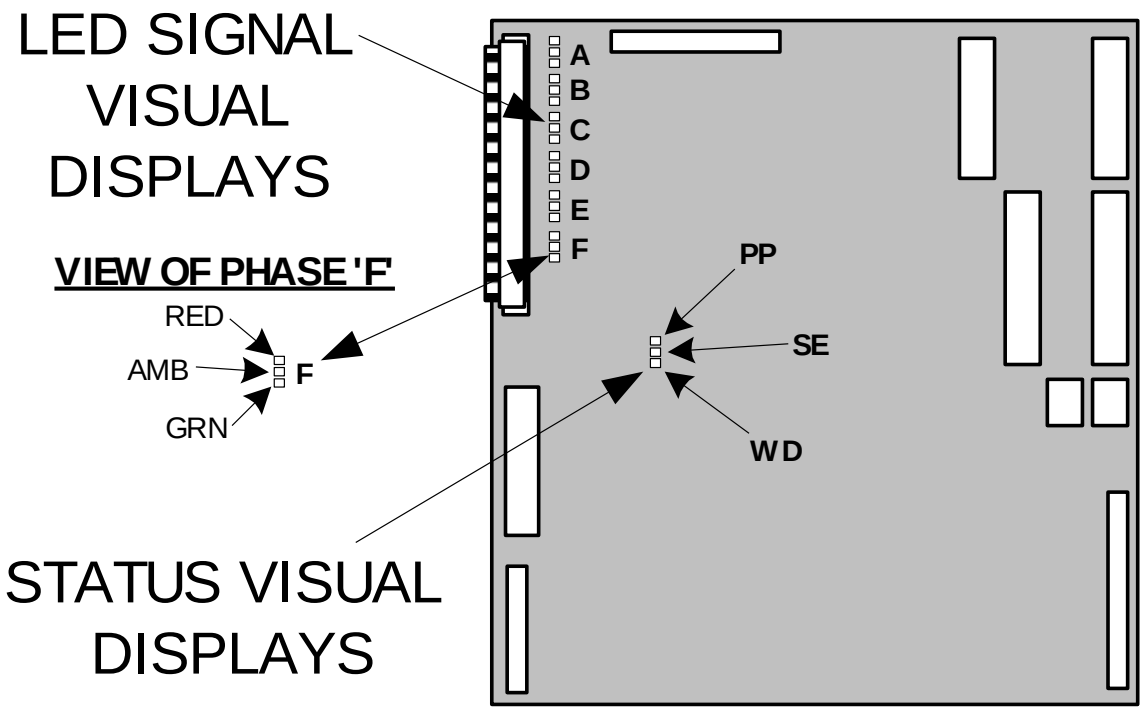


Figure 6 – CPU LEDs

4.2.1 Status LED Group

The top Status LED is green and is labelled ‘PP’ for power present. This LED flashes giving a heartbeat indication that the ST700 is running normally.

If it does not illuminate there is no power to the CPU PCB. Check that the ST700 is powered and that the Phase Control ribbon cable is inserted into the socket of the CPU PCB.

The other two LEDs are red and identify various fault conditions.

The top red LED is labelled ‘SE’ for system error. This illuminates during the power-up sequence and then extinguishes when the ST700 is running normally with no faults present in its fault log.

The bottom red LED is labelled ‘WD’ for watchdog. This LED is illuminated when the hardware watchdog circuit times-out. Note that when the firmware detects a serious fault, it extinguishes the signals and deliberately stops ‘kicking’ the hardware watchdog so that it times-out and reinforces the signals’ Off or Fail Flashing condition.

4.2.2 Signal LED Group

These LEDs are in groups of three, one for each traffic phase A to F. Each group has a red at the top, amber in the middle and green at the bottom (see View of Phase 'F' in Figure 6) to represent a set of traffic lights. They provide visual representation of the state of the red, amber and green drives for their respective phase.

4.3 FUSES

Figure 23 on page 98 lists the types and placing of fuses in the ST700. Fuses should only be replaced by ones of a similar rating and type.

4.4 DETECTOR CHASSIS AND PSU

The Detector Chassis is fitted at the top right hand side of the ST700 Cabinet frame; see Figure 5 for the exact position. This Detector chassis can be powered from the ST700 for up to 600ma at 24V.

If more detector power is required as for AGD units, then all detectors must be powered by an AC Detector PSU (24) Kit (see Appendix A for the part number). This Kit provides a maximum of 2A at 24V AC and can be mounted in one of three positions, depending on the existing equipment in the cabinet. The positions are detailed in Section 2.4.4 and on the AC Detector PSU (24V) kit drawing (see Section 1.3 for details).

5. INSTALLATION AND COMMISSIONING PROCEDURE FOR THE ST700

The majority of this section details the procedure for installing and commissioning the ST700 Rack Assembly in an ST700 Cabinet Assembly.

Refer to section 5.19 for instructions on installing and commissioning the ST700 Rack Assembly into other traffic controller cabinets.

5.1 PRE-INSTALLATION CHECKS

The following checks should be carried out at the depot and again at the roadside, with the exception of the pre-installation self-test which can only be carried out at the depot.

The Cabinet Assembly should be visually inspected to check for any damage that may have occurred in transit, e.g. cabinet damage, dents and scratches. Check the security of all internal wiring and board fixings, including all nuts and screws.

HARDWARE CHECK

Check against the Works Specification that:

- The correct boards and kit (including the Firmware PROMs and PLD) have been supplied and fitted correctly.

- The appropriate links have been made on the boards.

- All fuses and dummy fuses are fitted and are of the correct ratings.

- The correct interconnection cabling has been installed within the Cabinet Assembly, e.g. Detectors to Rack Assembly, OTU to Rack Assembly, etc.

- The dimming transformer (if fitted) tapings have been set to the correct voltages.

Once the hardware has been checked as above, it is recommended that a self-test is run (see section 7) before leaving the depot.

5.2 ST700 CABINET ASSEMBLY PREPARATION

Cabinet Assemblies are normally delivered from the factory in a fully assembled and tested state. However to aid installation, the internal equipment has been designed to be readily removable.

The cabinet Lid (also known as the case or the sleeve) is attached to the equipment mounting frame with a screwlock situated inside the manual panel door.

5.3 SITE SUITABILITY

The ST700 Cabinet Assembly is installed to suit local conditions, but subject to the following limitations:

(i) The position of the Cabinet Assembly is as shown on the relevant site plan, STS.

(ii) No part of the Cabinet is less than 457mm (18 inches) from the kerbside unless agreed with the customer.

When it is necessary to site the Cabinet less than 2 metres from the outer edge of the kerb, the access panels should not open toward the carriageway. Where no pedestrian guard rails are fitted, a clearance of at least 600mm should be left between the Cabinet and the kerb edge so that guard rails may be installed at a later date without the need to disturb the Cabinet installation.

(iii) Removal of the Cabinet Lid should be easily achieved without extending the Lid over the roadway or obstructing the footpath when removed. The dimensions of the Lid are 982mm x 375mm x 255mm. To remove it from the equipment mounting frame, it needs to be lifted up until it clears the inside Assembly, and then rested on top of the equipment mounting frame. This allows the Lid's Faston connector on the earth lead to be removed from the Faston Tag on the side flange (on Manual Panel side) of the ST700 Cabinet Assembly. The Lid is then free from the ST700 Cabinet Assembly. It must be stored in a suitable place so that it is not a danger to the general public and set down carefully to prevent scratching. The Earth Lead is permanently attached to a stud within the Lid with its flying end terminated with a Faston Tag.

(iv) Any person having control over the junction, whether manual control or test box simulation, MUST have a good view of the intersection.

(v) When the ST700 Cabinet Assembly is to be located on unmade ground (e.g. a grass verge) it is recommended that paving slabs or a concrete standing be provided at ground level on the manual panel (left) side and the front side. The hard standing shall extend a minimum distance of 900mm away from the door, extending the full width of the Cabinet Assembly, and at least 800mm away from the side of the cabinet with a flap, again extending the full width of that side. Customers may specify particular requirements.

5.4 RECOMMENDED ORDER OF INSTALLATION

The following list details the order in which it is recommended that an ST700 installation take place.

Remove the Lid – section 5.5
Remove the equipment mounting frame from the stool – section 5.6
Install the stool into the ground – section 5.7
Pull the cables into position – section 5.8
Terminate the armour to the CET connectors – section 5.8
Fit the CET connectors to the CET bars – section 5.8
Test the cables – section 5.9
In-fill the stool and seal the base – sections 5.10 and 5.11
Fit the equipment mounting frame – section 5.12
Terminate the cables – section 5.13
Check PCB links, switches and firmware – section 5.15
Refit the Lid – section 5.18.

Details of each of the actions are given in the following sections.

5.5 REMOVE THE LID

Remove the Lid from the ST700 Cabinet Assembly as detailed in section 5.3.

5.6 REMOVE THE EQUIPMENT MOUNTING FRAME FROM THE STOOL

Leaving the electronics in the equipment mounting frame, remove the stool by removing its four fixing screws (the nuts are captured on the stool) and lift the rest of the assembly off the stool.

The ST700 Cabinet Assembly in its sub-assembled state (in three pieces – the Lid, the stool and the equipment mounting frame) is now ready for installation.

5.7 INSTALL THE STOOL

A hole should be dug and a flagstone at least 600mm x 600mm embedded securely at the bottom of the hole. Refer to Figure 7 for the general method of installation and dimensions. Ensure that enough clearance is left around the stool to enable the correct fitting of the equipment mounting frame and Lid.

If the ST700 Cabinet is being installed on a slope, allowance must be made for ground level clearance of the Lid to the uphill side.

The stool is placed in the centre of the flagstone with the top surface between 50 and 75 mm above the final ground level. **It is essential that the stool be fitted the correct way round with the single centre edge holes to the front and the CET fixing holes on the right, as shown in** Figure 7**.** Adjustment may be required to ensure that the top of the stool is horizontal; this should be checked using a spirit level.

Mix up a stiff mixture of concrete (mix: 1 cement, 3 sand, 4 coarse aggregate (20mm) with no excess water) and cover the flagstone to a height approximately 100mm (4") above the bottom of the stool. The concrete must be sloped to provide a run up for the cables. Any cables that already enter the pit must be held away from the wet concrete. Where there is a risk of freezing, a suitable antifreeze additive should be incorporated in the concrete mix to ensure proper curing.

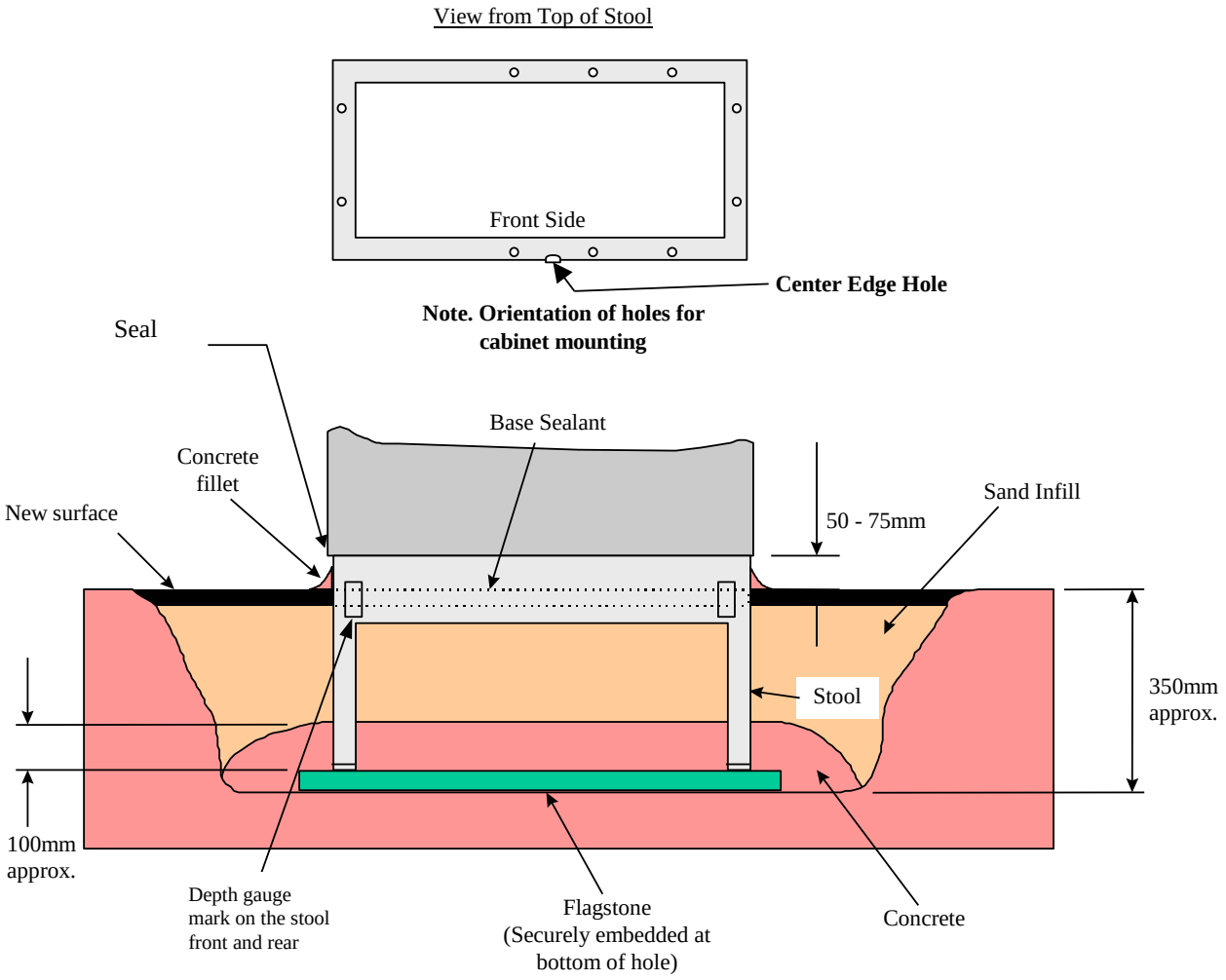


Figure 7 – Stool Installation

5.8 CABLING TO THE ST700 CABINET ASSEMBLY

All cables into the ST700 Cabinet Assembly should be fed into the equipment mounting frame as close to their termination positions as possible. This is to prevent unnecessary damage being caused should any cables need to be moved once they are in place. Care must be taken not to obstruct the Electricity Supply Company cut-out with any cabling.

The outer sheathing must be stripped to expose the armouring. It is suggested that between 55mm and 65mm of the inner sheathing is left above the Hose Clip and stripped armour (see Figure 8), which is more than normally required for other Cabinet Assemblies. This is due to the height of the CET bar and its staggered fixing nature. The additional height ensures that double insulation is provided where the cable rests against the metal items. Sufficient further conductor length must also be allowed to reach the terminal blocks via the proper routing.

The cable is inserted in the CET ring and the armoured wires are bent outwards and down against the ring. A hose clip is then placed over the armoured wires and tightened up. The armouring must be stripped, leaving a small amount (approx. 0 to 2mm) below the level of the CET ring.

The inner sheathing is removed to expose the individual leads that are connected to associated terminals, leaving sufficient spare length for re-making off the ends should this become necessary. Unused leads should be left with sufficient length to enable them to be connected to any terminal should this subsequently become necessary.

The ST700 can be fitted with up to 3 CET bar kits.

The CET bars are mounted directly on the stool, which has three positions onto which these bars can be fitted. Each bar has 8 holes for fixing cables; 4 upper and 4 lower fixing positions. This allows the CET rings and hose clips to overlap each other. Up to 24 cables can be fitted in the ST700 cabinet. Refer to drawing 667/GA/27845/000 for further details of fixing.

When the detector loop tails have been terminated the connection to the detector backplane must be made with wires twisted together as pairs. Ensure that individual pairs connect only to the same detector.

See also the Detector Information Handbook.

Cables must be identified as to their destinations. Additional Idents may be required on specific contracts.

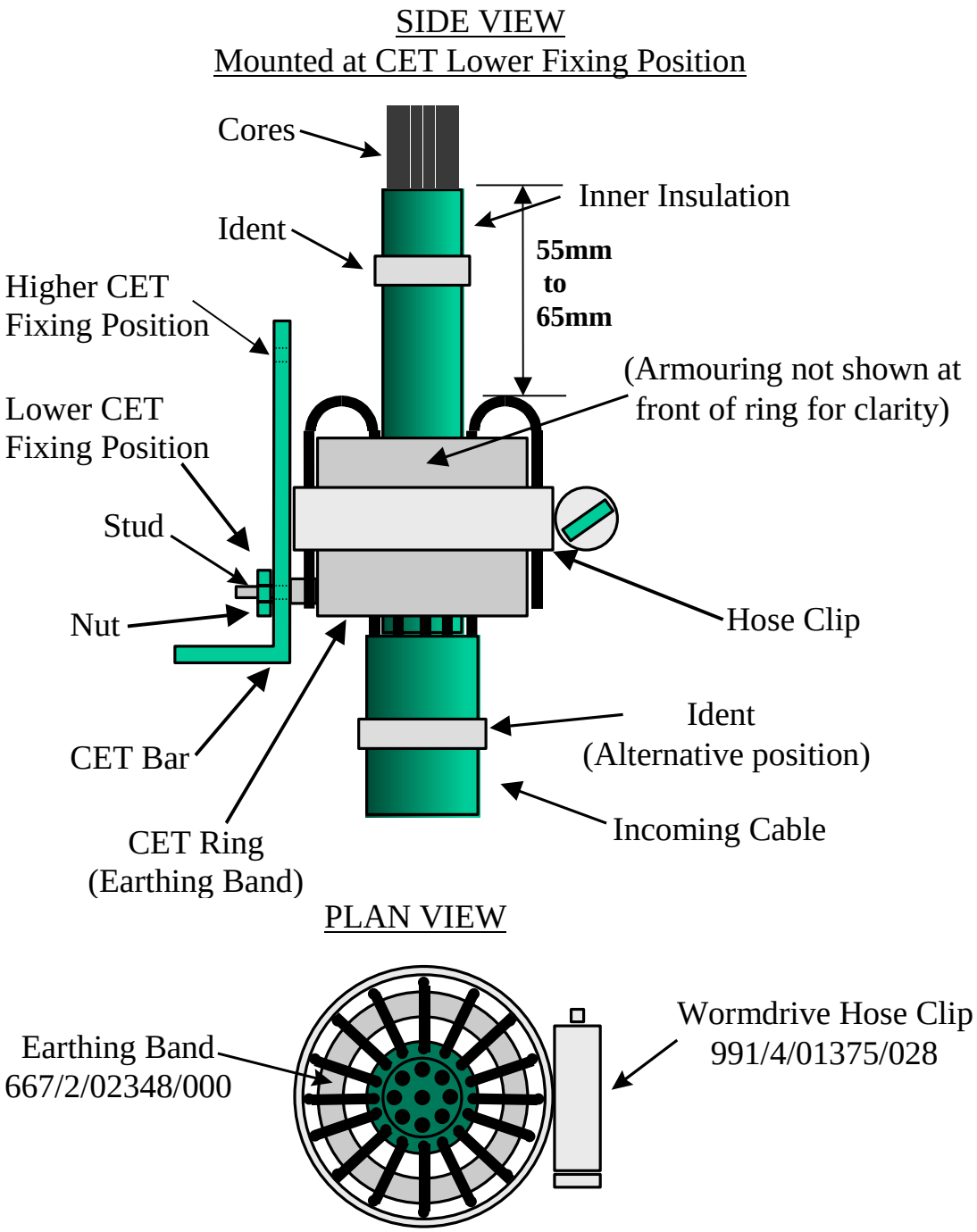


Figure 8 – Termination of Armoured Cable to CET bar

5.9 ON SITE CABLE TESTING

When all the cables have been terminated onto the CET bar they should be checked and tested as defined in the General Testing handbook.

5.10 IN-FILL THE STOOL

On completion of the cable tests the Cabinet Assembly can be in-filled as per Figure 7, taking care that the compacted sand is at ground level when finished.

If any of the cables were replaced or moved during the installation of the Cabinet Assembly then the sand in-filling must be made good before the sealing compound is introduced.

NOTE: The in-filling must be brought to ground level or above and compacted and a tarmac surface provided over the in-fill.

5.11 SEAL THE BASE

To prevent condensation in the Cabinet Assembly the equipment mounting frame base must be sealed as soon as possible after the ST700 has been installed.

The sealant should be poured all around the cables and to a height which, when the sealant is set, gives a total covering not less than 6.5mm thick over the base of the Cabinet Assembly. This is to prevent the ingress of moisture.

Approx. 2.0Kg of Robnorganic PX212ZF or similar base seal epoxy should be adequate.

A concrete fillet around the outside of the stool may be completed before or after the epoxy sealing to suit site conditions.

Refer to Figure 7 for general method of in-fill, sealing and concrete fillet.

5.12 FIT THE EQUIPMENT MOUNTING FRAME TO THE STOOL

If the equipment mounting frame was not installed with the mounting stool then it should be done as follows:

Clean the top surface of the stool and the lower surface of the equipment mounting frame that will be in contact when the equipment mounting frame is fitted. Apply a spot of sealant compound to each of the front and rear left hand corners (Manual Panel side) of the equipment mounting frame.

The equipment mounting frame is installed by lowering it onto the stool and fitting the four retaining bolts.

When fitting the equipment mounting frame onto the stool, make sure that all the cables are in their correct position with regard to the CET bar. Once the equipment mounting frame has been secured, moving cables could cause damage.

5.13 CABLE ROUTING & TERMINATION

The following guidelines apply when the ST700 Rack Assembly is installed in the ST700 Cabinet Assembly or any other controller cabinet.

All intersection cables and their wires must be run up the inside back right hand corner of the ST700 equipment mounting frame and secured to it with tywraps. This is the cable/wire position to mount any external current monitoring coils. The preferred route for the detector cables and their wires is to run over the top of the dimming transformer (if fitted) and up the left hand side of the ST700 equipment mounting frame and then over the top of the ST700 Rack Assembly (see the following note). Although the right hand side can be used if there is sufficient room.

Note: No wire runs or looms should be positioned directly above the ST700 Rack Assembly, as this would prevent its removal for maintenance or replacement. In the back of the metal frame across the top of the ST700 Rack Assembly, securing holes are provided to secure the detector wire looms. These holes ensure that there is sufficient room to allow the removal of the ST700 Rack Assembly.

Wiring runs should be made neatly and routed to allow enough spare cables for possible changes/additions at a later date.

Spare cores are to be bundled and routed to a convenient position clear of mains. The ends are to be insulated to make the loom secured. Spare cores of ELV cables are to be loomed separately from the cores of LV cables. **Note**: Normally spare cores are earthed at the end furthest from the Rack Assembly.

If cable idents are required then these are fitted to cores before termination.

Signal and Detector terminations to the ST700 Rack Assembly should be as per the Works Specification, leaving sufficient spare wire to enable joints to be remade when necessary. The ‘Pair’ cable used for connection from the loops should be terminated using the appropriate kit.

OMU must monitor the Controller Lamp Supply at the screw terminal on SK2 Pin 6.

Note: The following connectors’ identification, signal allocation, coding information (when required) and Softwire colours (when used) are given as guidance to assist the installation engineer, when wiring to the Works Specification. No Softwire Kit is required to wire an ST700 Rack Assembly into an ST700 Cabinet as the Intersection Cables can be wired directly to the ST700 terminals. Softwire Kits are available to install an ST700 in other Cabinets. If the Softwire kit is used in the ST700 cabinet assembly, then their associated terminal blocks are mounted on the right hand side and back of the cabinet’s inner metal frame. The position of these terminal blocks means that a short screwdriver (No1 Pozidriv) is required to terminate the wires due to the proximity of the dimming transformer (if fitted). If there are many cables, access to the terminal blocks becomes restricted.

5.13.1 Phase Drive PCB Terminal blocks

For installation in an ST700 Cabinet, wire the intersection cables directly to the specified connector in the following tables (using the respective mating half contained in the attached plastic bag) on the Phase Drive PCB.

The connectors must be wired as follows:

- Ensure 10mm of wire insulation is stripped back
- Make sure that the connector is fully undone (open) before inserting the stripped wire end
- Insert the stripped wire end fully to the back stop
- Firmly tighten the connector's terminal screw ensuring that the wire's conductor is firmly positioned correctly in the connector

Warning: The above method must be used. Failure to do so could result in the wires coming loose or falling out over a short period of time.

For installation in another cabinet, a Softwire Kit is required. Wire the loose ends of the Softwire kit Cableform to the cabinet terminal blocks. Use the relevant signals as defined by the works specification and shown in the tables that follow. Figure 9 also provides further information on PL6, PL7 and PL8.

Table 5 – Phase Drive PL6 Connector

PL6 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/000	
		Colour	Ident
1	Red Phase A (Unmonitored)	Red	RAU
2	Monitored Red Phase A Approach 1		
3	Monitored Red Phase A Approach 1	Red	RA1
4	Monitored Amber Phase A Approach 1	Yellow	YA1
5	Monitored Green Phase A Approach 1	Green	GA1
6	Monitored Red Phase A Approach 2		
7	Monitored Red Phase A Approach 2	Red	RA2
8	Monitored Amber Phase A Approach 2	Yellow	YA2
9	Monitored Green Phase A Approach 2	Green	GA2
10	*Not used (for isolation purposes)*		
11	Red Phase B	Red	RB
12	*Not used (for isolation purposes)*		
13	Amber Phase B	Yellow	YB
14	Amber Phase B		
15	*Not used (for isolation purposes)*		
16	Green Phase B	Green	GB

Coding Details: The plug mount connector on the Phase Drive board PL6 has coding pins 2 and 15 fitted, with the cable fitted socket connector

that mates with PL6 having coding pins 1 and 16 fitted. This coding prevents the incorrect connection between PL6 and PL7. For more details see the following diagram:

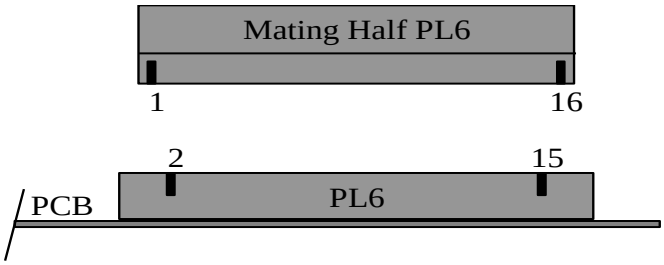


Table 6 – Phase Drive PL7 Connector

PL7 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/000	
		Colour	Ident
1	Red Phase C (Unmonitored)	Red	RAU
2	Monitored Red Phase C Approach 1		
3	Monitored Red Phase C Approach 1	Red	RA1
4	Monitored Amber Phase C Approach 1	Yellow	YA1
5	Monitored Green Phase C Approach 1	Green	GA1
6	Monitored Red Phase C Approach 2		
7	Monitored Red Phase C Approach 2	Red	RA2
8	Monitored Amber Phase C Approach 2	Yellow	YA2
9	Monitored Green Phase C Approach 2	Green	GA2
10	*Not used (for isolation purposes)*		
11	Red Phase D	Red	RB
12	*Not used (for isolation purposes)*		
13	Amber Phase D	Yellow	YB
14	Amber Phase D		
15	*Not used (for isolation purposes)*		
16	Green Phase D	Green	GB

Coding Details: The plug mount connector on the Phase Drive board PL7 has coding pins 1 and 16 fitted, with the cable fitted socket connector that mates with PL7 having coding pins 2 and 15 fitted. This coding prevent the incorrect connection between PL7 and PL6. For more details see the following diagram:

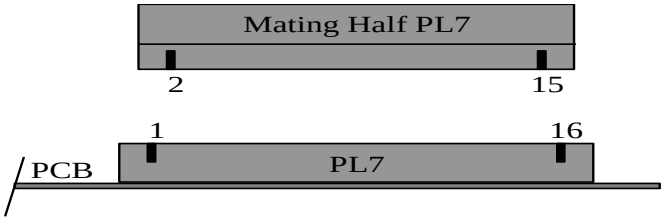


Table 7 – Phase Drive Export 6 Phase Controllers PL6,7 and 8 Connectors

PL6 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/000	
		Colour	Ident
1	Red Phase A (Unmonitored)	Red	RAU
2	Not used		
3	Red Phase A (Unmonitored)	Red	RA1
4	Amber Phase A (Unmonitored)	Yellow	YA1
5	Green Phase A (Unmonitored)	Green	GA1
6	Not used		
7	Red Phase A (Unmonitored)	Red	RA2
8	Amber Phase A (Unmonitored)	Yellow	YA2
9	Green Phase A (Unmonitored)	Green	GA2
10	*Not used (for isolation purposes)*		
11	Red Phase B (Unmonitored)	Red	RB
12	*Not used (for isolation purposes)*		
13	Amber Phase B (Unmonitored)	Yellow	YB
14	Not used		
15	*Not used (for isolation purposes)*		
16	Green Phase B (Unmonitored)	Green	GB

PL7 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/000	
		Colour	Ident
1	Red Phase C (Unmonitored)	Red	RAU
2	Not used		
3	Red Phase C (Unmonitored)	Red	RA1
4	Amber Phase C (Unmonitored)	Yellow	YA1
5	Green Phase C (Unmonitored)	Green	GA1
6	Not used		
7	Red Phase C (Unmonitored)	Red	RA2
8	Amber Phase C (Unmonitored)	Yellow	YA2
9	Green Phase C (Unmonitored)	Green	GA2
10	*Not used (for isolation purposes)*		
11	Red Phase D (Unmonitored)	Red	RB
12	*Not used (for isolation purposes)*		
13	Amber Phase D (Unmonitored)	Yellow	YB
14	Not used		
15	*Not used (for isolation purposes)*		
16	Green Phase D (Unmonitored)	Green	GB

PL8 Pin No	Signal Phase Drive O/P	Softwire kit Cableform 667/1/27877/050	
		Colour	Ident
1	Red Phase E (Unmonitored)	Red	RED5
2	Amber Phase E (Unmonitored)	Red	YLW5
3	Green Phase E (Unmonitored)	Yellow	GRN5
4	Red Phase F (Unmonitored)	Green	RED6
5	Amber Phase F (Unmonitored)	Red	YLW6
6	Green Phase F (Unmonitored)	Yellow	GRN6

Coding Details: The coding details for Plugs PL6 and PL7 is idendical to that of the Standard UK pedestrian controllers shown in tables 5 and 6 above ,PL8 This connector has no coding element, as it is the only 6-way connector.

Figure 9 – Allocation of Red Lamp Monitor Channels

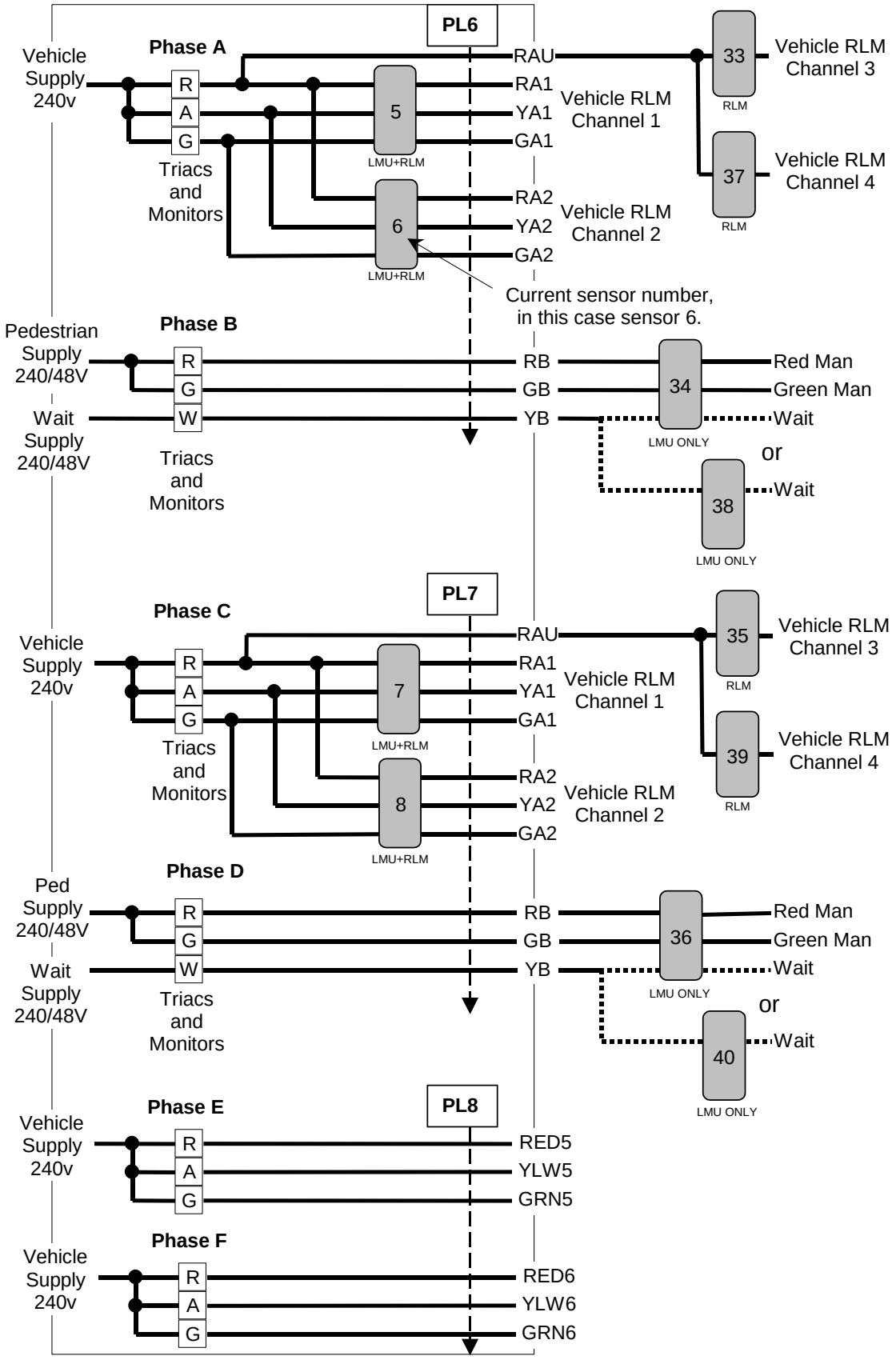


Table 8 – Phase Drive SK1 Connector

SK1 Pin No	Signal Phase Drive Returns, Solar Cell, Detector and AUX mains supplies	Softwire kit Cableform 667/1/27872/000		
		Colour	Ident	TB1
1	Signal Lamp Supply Return	Blue	None	4
2	Signal Lamp Supply Return	See note 1		
3	Signal Lamp Supply Return	See note 1		
4	Signal Lamp Supply Return	See note 1		
5	Signal Lamp Supply Return	See note 1		
6	Signal Lamp Supply Return	See note 1		
7	Signal Lamp Supply Return	Blue	None	12
8	Aux Mains Supply			
9	Aux Mains Supply 2 (not used)			
10	230V Detector Supply	Pink	DET	2
11	Solar Cell Live	Pink	SOLAR LIVE	3
12	Solar Cell Input	Pink	SOLAR CELL	1
13	*Not used (for isolation purposes)*			
		Softwire kit Cableform 667/1/27864/000		
		Colour	Ident	TB1
14	48V Lamp Supply Return	Orange	None	6
15	48V Lamp Supply Return	See note 2		
16	48V Lamp Supply Return	See note 2		
17	48V Lamp Supply Return	Orange	None	12

Note 1 These neutrals are not used as TB1 block part of cable form is linked between terminals 4 to 12, but these outputs can be used when wired direct in an ST700 cabinet installation.

Note 2 These 48V returns are not used as TB1 block part of cable form is linked between terminals 6 to 12, but these outputs can be used when wired direct in an ST700 cabinet installation.

Coding Details: Connector SK1 has no coding elements as it is the only 17-way connector and can only be inserted one way.

Table 9 – Phase Drive PL1 Connector

PL1 Pin No	Controller Mains I/P	Softwire kit Cableform 667/1/27874/000 or /001
		Colour
1	Live 230V Mains Supply	Pink
2	Neutral 230V Mains Supply	Blue
3	Earth Connection	Green/Yellow

Coding Details: Connector PL1 has no coding elements, as it is the only 3-way connector and can only be inserted one way.

Table 10 – Phase Drive SK2 Connector No Dimming

If the installation has no Dimming Transformer, then insert the Cableform 667/1/27868/002. This cable is provided as standard with rack assemblies. Cabinet assemblies have a dimming transformer fitted as standard, which includes the cable 667/1/27868/000. See Table 11 below for details.

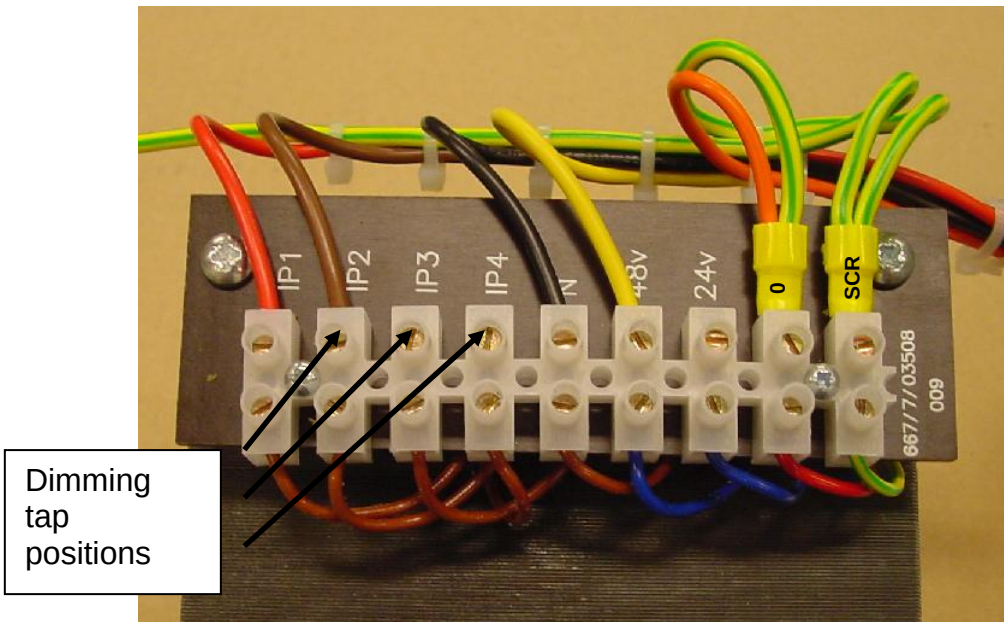
SK2 Pin No	Softwire kit Cableform 667/1/27868/002
	Connection
1	-
2	-
3	Short to pin 6
4	Short to pin 5
5	Short to pin 4
6	Short to pin 3
7	-
8	-
9	-
10	-

Table 11 – Phase Drive SK2 48V Dimming Connections

Normally the ST700 in its own cabinet is fitted with the cable 667/1/27868/000 described below (see also Figure 10):

SK2 Pin No	48V Dimming Transformer's I/P	Softwire kit Cableform 667/1/27868/000	
		Colour	Dim Transformer Connection
1	Dim I/P 1	Red	I/P1
2	Dim I/P 2, 3 or 4	Brown	I/P 2 etc
3	Dim Relay Common		Short to pin 5
4	Dim Relay n/c		Short to pin 6
5	B Relay O/P		Short to pin 3
6	Lamp Supply		Short to pin 4
7	Neutral	Black	Neutral
8	Not used		
9	48V Supply	Yellow	48V
10	48V Return	Orange	0V

Figure 10 - Dimming Transformer Tap Selection



Required Dimming voltage	Input Tap
160V	IP2
140V	IP3
120V	IP4

If the ST700 is installed in another cabinet, the 667/1/27868/001 cable should be used with connections as shown above. This cable is provided with the cabinet modification kit.

Note 1: The links between pins 3 to 6 need to be rearranged.
Note 2: The Screen (SCR) and 48V Return connections on the Dimming Transformer need to be linked together and connected to the Earth Star point in the controller cabinet with a length of yellow/green wire.

Coding Details: Connector SK2 has no coding elements, as it is the only 10-way connector and can only be inserted one way.

Table 12 – Phase Drive PL5 Connector

PL5 Pin No	External Lamp Monitoring Sensors
1	External Sensor 33 – Red
2	External Sensor 33 – White
3	External Sensor 34 – Red
4	External Sensor 34 – White
5	External Sensor 35 – Red
6	External Sensor 35 – White

PL5	External Lamp Monitoring Sensors
7	External Sensor 36 – Red
8	External Sensor 36 – White
9	External Sensor 37 – Red
10	External Sensor 37 – White
11	External Sensor 38 – Red
12	External Sensor 38 – White
13	External Sensor 39 – Red
14	External Sensor 39 – White
15	External Sensor 40 – Red
16	External Sensor 40 – White

Coding & Wiring Details: Connector PL5 is a 20-way Berg connector that has a side flange coding element, which mates with the associated slot of the IDC board mounted 16-way connector. The pin positions 1, 2, 19 & 20 on the Berg connector are not used for wiring purposes but are used to provide a stop for the IDC board mounted connector locking levers. See the following diagram:

Connector PL5 and its Mating Half (Berg Connector) Viewed from the Top

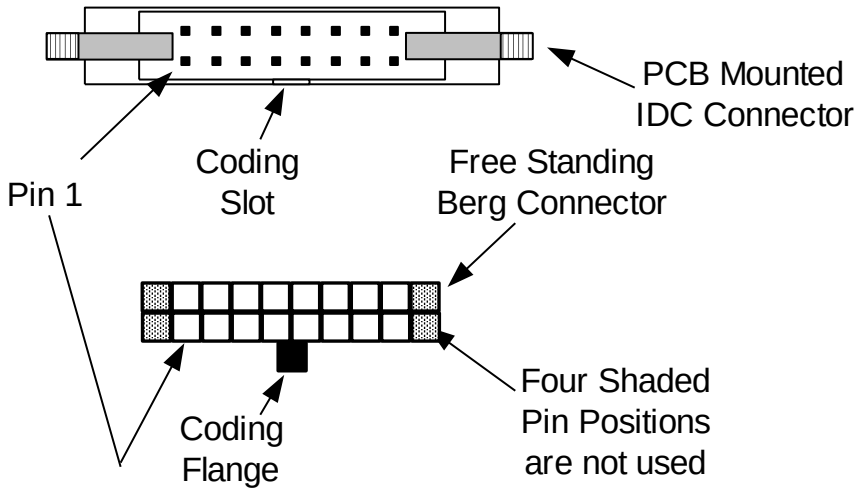


Figure 11 – Connector PL5

Instead of driving all the signals at the 230V nominal supply, the ST700 is capable of driving the Wait indicators or all the pedestrian phase signals directly with an ELV 48V lamp supply.

Switching the supply from 230V to 48V requires fuses and links on the lamp switch card to be re-arranged as detailed in Section 5.15. The required arrangement also

needs to be configured (using the ELV handset command) and affects what sensors 34 and 38 (or 36 and 40 on the second stream) can monitor. See the following table:

ELV:0 – All signals at 230v	ELV:1 – Waits at 48v	ELV:2 – All ped signals at 48v
34/36 – Monitor Red+Green+Wait (all cables thro' torroid twice)	34/36 – Monitor Red+Green+Wait *1 (Red & Green thro' torroid twice) (Wait cables thro' torroid once)	34/36 – Monitor Red+Green+Wait *2 (all cables thro' torroid once)
38/40 – Not Required.	38/40 – Can be used to monitor Wait (Wait cables thro' torroid once)	38/40 – Can be used to monitor Wait (all cables thro' torroid once)

Sensors 34 and 36 can be used to monitor the Wait Indicators as well as the Red+Green signals as long as the total current seen by the torroid when the Red Man and Wait signals are illuminated is less than 4 Amps, otherwise sensors 38 and 40 must be used to monitor the Waits separately.

*1 (ELV:1) Since the Red and Green cables go through the torroid twice, the current seen by the torroid for those aspects is doubled, so for example:

2x 50W Red Man Halogens (at 230V)
= 2 x 0.22A = 0.44A
2x 40W Wait Indicators (at 48V)
= 2 x 0.83A = 1.67A
} 2 x 0.44 + 1.67 = 2.55A < 4.00A
} So sensor 34/36 can monitor Red+Green+Wait.

2x 50W Red Man Halogens (at 230V)
= 2 x 0.22A = 0.44A
4x 40W Wait Indicators (at 48V)
= 4 x 0.83A = 3.33A
} 2 x 0.44 + 3.33 = 4.21A > 4.00A
} So monitor Waits with sensor 38/40.

Also note that the load displayed for sensors 34 and 36 while monitoring 'Red+Wait' will be higher than expected as the current taken by the 48V Wait is much larger than the current taken by the 230V reds.

*2 (ELV:2) Since all the cables only go through the torroid once when being driven at 48V, the calculations are simpler:

2x 20W Near Side Reds (at 48V)
= 2 x 0.42A = 0.83A
2x 40W Wait Indicators (at 48V)
= 2 x 0.83A = 1.67A
} 0.83 + 1.67 = 2.50A < 4.00A
} So sensor 34/36 can monitor Red+Green+Wait.

4x 20W Near Side Reds (at 48v)
= 4 x 0.42A = 1.67A
4x 40W Wait Indicators (at 48v)
= 4 x 0.83A = 3.33A
} 1.67 + 3.33 = 5.00A > 4.00A
} So monitor Waits with sensor 38/40.

Note however that at the time of writing, the controller is unable to monitor the current waveform generated by the low power near-sided signals currently on the market.

Wiring of external torroids
All drive cables supplying signals at 230V should be wound around the torroid so the cable passes through the centre twice. (N.B. This includes vehicle aspects as well as pedestrian aspects.)

All drive cables supplying signals at 48V should only pass through the centre of the torroid once.

5.13.2 ST700 CPU PCB Terminal Blocks

When installing in an ST700 cabinet, wire the intersection cables directly to the specified connector in the following tables (using the respective mating half contained in the attached plastic bag) on the ST700 CPU PCB.

The connectors must be wired as follows:
- Ensure 9mm of wire insulation is stripped back
- Make sure that the connector is fully undone (open) before inserting the stripped wire end
- Insert the stripped wire end fully to the back stop
- Firmly tighten the connector's terminal screw ensuring that the wire's conductor is firmly positioned correctly in the connector

Warning: **The above method must be used. Failure to do so could result in the wires coming loose or falling out over a short period of time. Also, the connectors PL2, PL3, PL6 and PL7 require a small-ended (2.5mm) screwdriver. Use a Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent (see note at the top of each table).**

When installing in any other cabinet, a Softwire kit is required. Wire the loose wire ends of the Softwire kit cableform to the terminal blocks in the cabinet, using the relevant signals as defined by the works specification and shown in the tables that follow:

Table 13 – Processor Card PL3 Connector

Note: These terminals must be tightened correctly, using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL3 PCB Connector Pin No	Controller Isolated O/P, Tactile and Audible Circuits	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	O/P 88 Common	Brown	TBX1
2	O/P 88 Closed Contact	Red	TBX2

PL3 PCB	Controller Isolated O/P, Tactile and Audible	Softwire Kit Cableform 667/1/27863/100	
3	O/P 89 Common	Orange	TBX3
4	O/P 89 Closed Contact	Yellow	TBX4
5	O/P 90 Common	Green	TBX5
6	O/P 90 Closed Contact	Blue	TBX6
7	O/P 90 Open Contact	Not used	-
8	O/P 91 Common	Slate	TBX7
9	O/P 91 Closed Contact	White	TBX8
10	O/P 91 Open Contact	Not used	-
11	Tactile Phase B	Red/Orange	TBX10
12	Audible Phase B Loud	Red/Green	TBX11
13	Audible Phase B Quiet	Red/Brown	TBX12

Coding Details: The plug mount connector on the CPU PCB PL3 has coding pins 2, 8 and 13 fitted, with the cable fitted socket connector that mates with PL3 having coding ridges 2, 8 and 13 removed. This coding prevent the incorrect connection between PL3 and PL2. For more details see the following diagram:

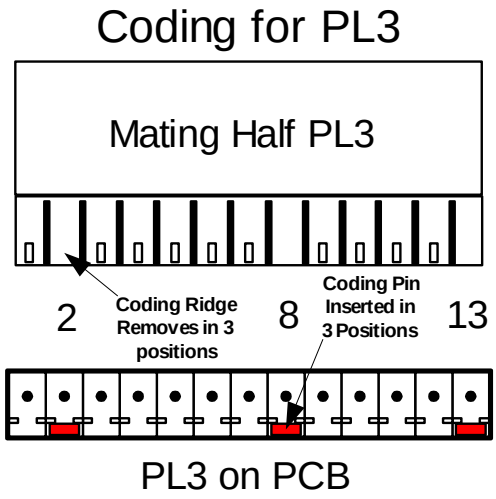


Figure 12 – Connector PL3

Table 14 – Processor Card PL7 Connector

Note: These terminals must be tightened correctly using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL7 PCB Connector Pin No	Controller I/P	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	Input 0	Brown	TBG1
2	Input 1	Red	TBG2

PL7 PCB	Controller I/P	Softwire Kit Cableform 667/1/27863/100	
3	Input 2	Orange	TBG3
4	Input 3	Yellow	TBG4
5	Input 4	Green	TBG5
6	Input 5	Blue	TBG6
7	Input 6	Violet	TBG7
8	Input 7	Slate	TBG8
9	Input 8	White	TBH1
10	Input 9	Black	TBH2
11	Input 10	Red/Orange	TBH3
12	Input 11	Red/Green	TBH4
13	Input 12	Red/Brown	TBH5
14	Input 13	Green/Orange	TBH6
15	Input 14	Green/Brown	TBH7
16	Input 15	Green/Slate	TBH8

Coding Details: The plug mount connector on the CPU PCB PL7 has coding pins 2, 8 and 16 fitted, with the cable fitted socket connector that mates with PL7 having coding ridges 2, 8 and 16 removed. This coding prevents the incorrect connection between PL7 and PL6. For more details see the following diagram:

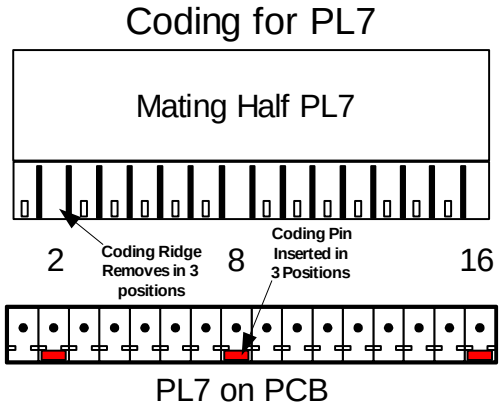


Figure 13 – Connector PL7

Table 15 – Processor Card PL2 Connector

Note: These terminals must be tightened correctly using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL2 PCB Connector Pin No	Controller Isolated O/P, Tactile and Audible Circuits	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	O/P 92 Common	Brown	TBY1

PL2 PCB	Controller Isolated O/P, Tactile and Audible	Softwire Kit Cableform 667/1/27863/100	
2	O/P 92 Closed Contact	Red	TBY2
3	O/P 93 Common	Orange	TBY3
4	O/P 93 Closed Contact	Yellow	TBY4
5	O/P 94 Common	Green	TBY5
6	O/P 94 Closed Contact	Blue	TBY6
7	O/P 94 Open Contact	Not used	-
8	O/P 95 Common	Slate	TBY7
9	O/P 95 Closed Contact	White	TBY8
10	O/P 95 Open Contact	Not used	-
11	Tactile Phase D	Red/Orange	TBY10
12	Audible Phase D Loud	Red/Green	TBY11
13	Audible Phase D Quiet	Red/Brown	TBY12

Coding Details: The plug mount connector on the CPU PCB PL2 has coding pins 1, 6 and 12 fitted with the cable fitted socket connector that mates with PL2 having coding ridges 1, 6 and 12 removed. This coding prevent the incorrect connection between PL2 and PL3. For more details see the following diagram:

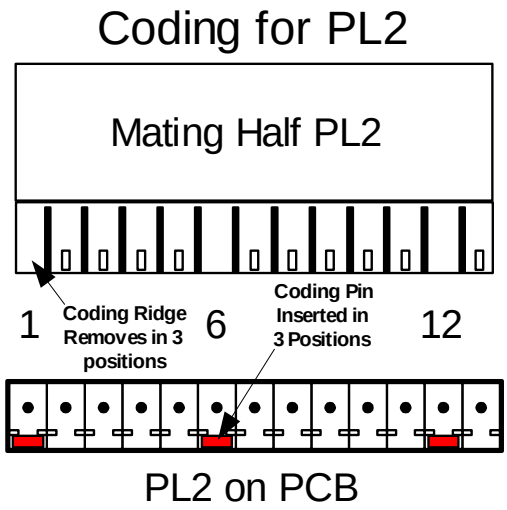


Figure 14 – Connector PL2

Table 16 – Processor Card PL6 Connector

Note: These terminals must be tightened correctly using Phoenix Screwdriver Part Number SZS 0.4 x 2,5 or equivalent.

PL6 PCB Connector Pin No	Controller I/P	Softwire Kit Cableform 667/1/27863/100	
		Colour	Terminal Block Pin No
1	Input 16	Brown	TBJ1

PL6 PCB	Controller I/P	Softwire Kit Cableform 667/1/27863/100	
2	Input 17	Red	TBJ2
3	Input 18	Orange	TBJ3
4	Input 19	Yellow	TBJ4
5	Input 20	Green	TBJ5
6	Input 21	Blue	TBJ6
7	Input 22	Violet	TBJ7
8	Input 23	Slate	TBJ8
9	Input 24	White	TBL1
10	Input 25	Black	TBL2
11	Input 26	Red/Orange	TBL3
12	Input 27	Red/Green	TBL4
13	Input 28	Red/Brown	TBL5
14	Input 29	Green/Orange	TBL6
15	Input 30	Green/Brown	TBL7
16	Input 31	Green/Slate	TBL8

Coding Details: The plug mount connector on the CPU PCB PL6 has coding pins 1, 7 and 15 fitted, with the cable fitted socket connector that mates with PL6 having coding ridges 1, 7 and 15 removed. This coding prevent the incorrect connection between PL6 and PL7. For more details see the following diagram:

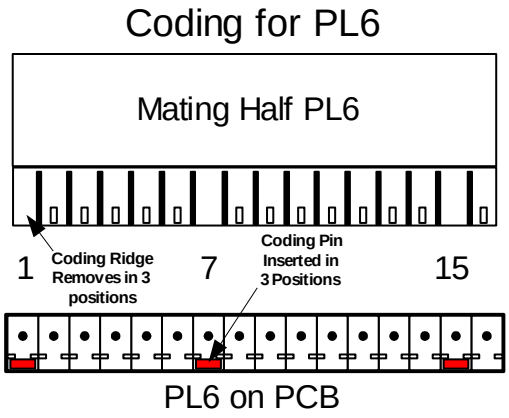


Figure 15 – Connector PL6

5.14 REGULATORY SIGNS MONITORING

The ST700 Rack Assembly does not cover regulatory signs and their associated monitoring. There is a fuse position labelled ‘F3 Detector’ which could be used to supply regulatory signs if required. Their monitoring would require standard current coils to be connected to the external analogue inputs.

5.15 PCB SWITCHES, FUSES, LINKS AND FIRMWARE

The switches, fuses and link settings are related to the hardware options; their locations and option selections are shown in Sections 5.15.1 and 5.15.2.

To aid the location identification an overview of each card is also given:

5.15.1 CPU PCB Switch and Link Setup

See the following pages for switch and link settings.

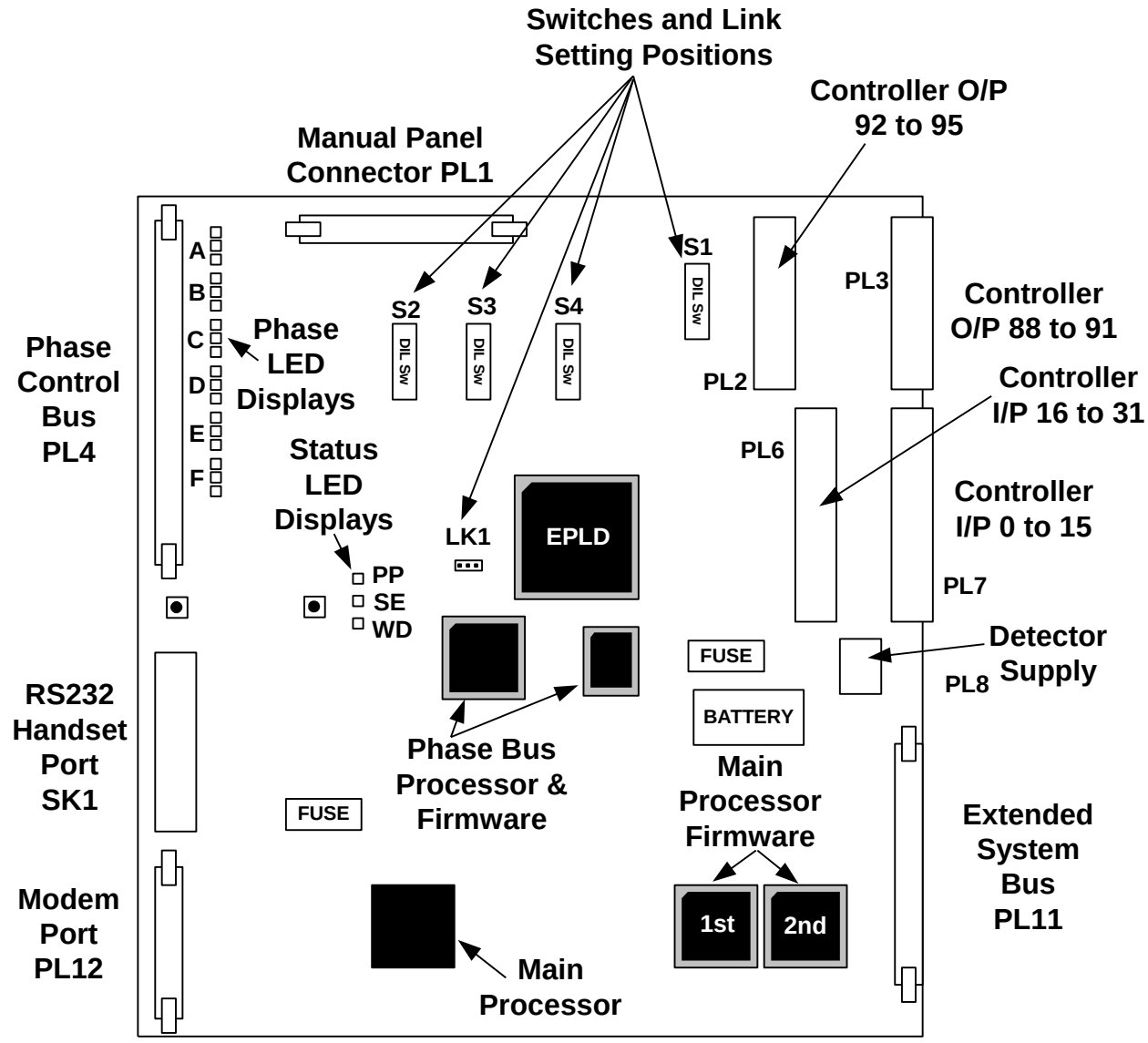


Figure 16 – CPU PCB

5.15.1.1 DIL Switch S4 Settings

For use in the UK, the hardware fail flash facility should be disabled. The settings are shown in Figure 17.

For use in Export versions, the flash rate can be set to different speeds for 40ms to 600ms (on 50Hz operation) by setting the right combination of S4 switches to the off position. The set-up is detailed as follows:

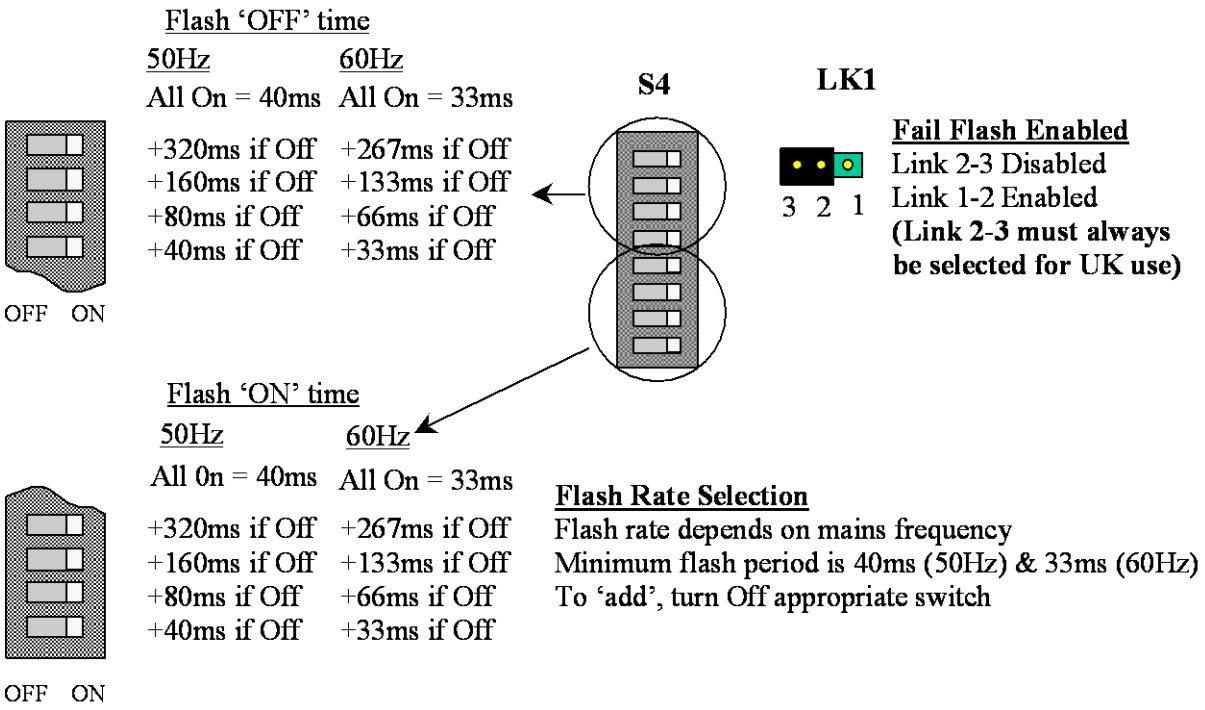


Figure 17 – Flash Rate Settings

5.15.1.2 DIL Switch S2 & S3 Settings

For use in the UK these switches should be set to the OFF position. The settings are shown in Figure 18.

For export versions, each of the six phases can be set individually to flash either Red (using S2) or Amber (using S3), or both Red and Amber when the hardware fail flash is activated.

The set-up of each phase to the required colours is detailed as follows:

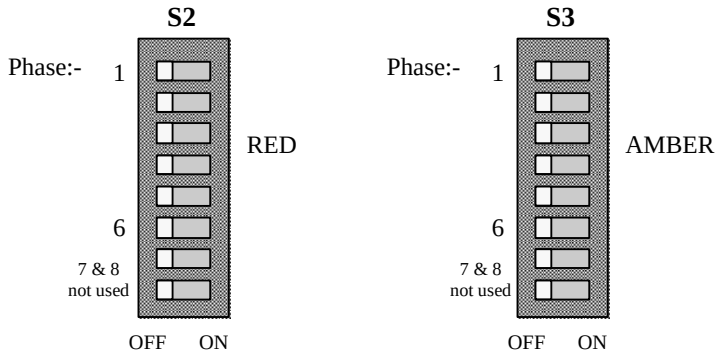


Figure 18 – Phase Output Flash Selection

5.15.1.3 DIL Switch S1 Settings

The value of the series resistance for the relay contacts can be set to either 182 ohms or 22 ohms and is set on switch S1 as follows:

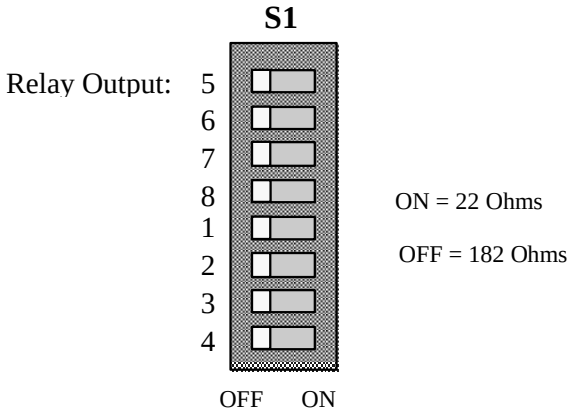


Figure 19 – Relay Output Resistance Selection

5.15.2 Phase Drive PCB Switches, Links and Fuses Setup

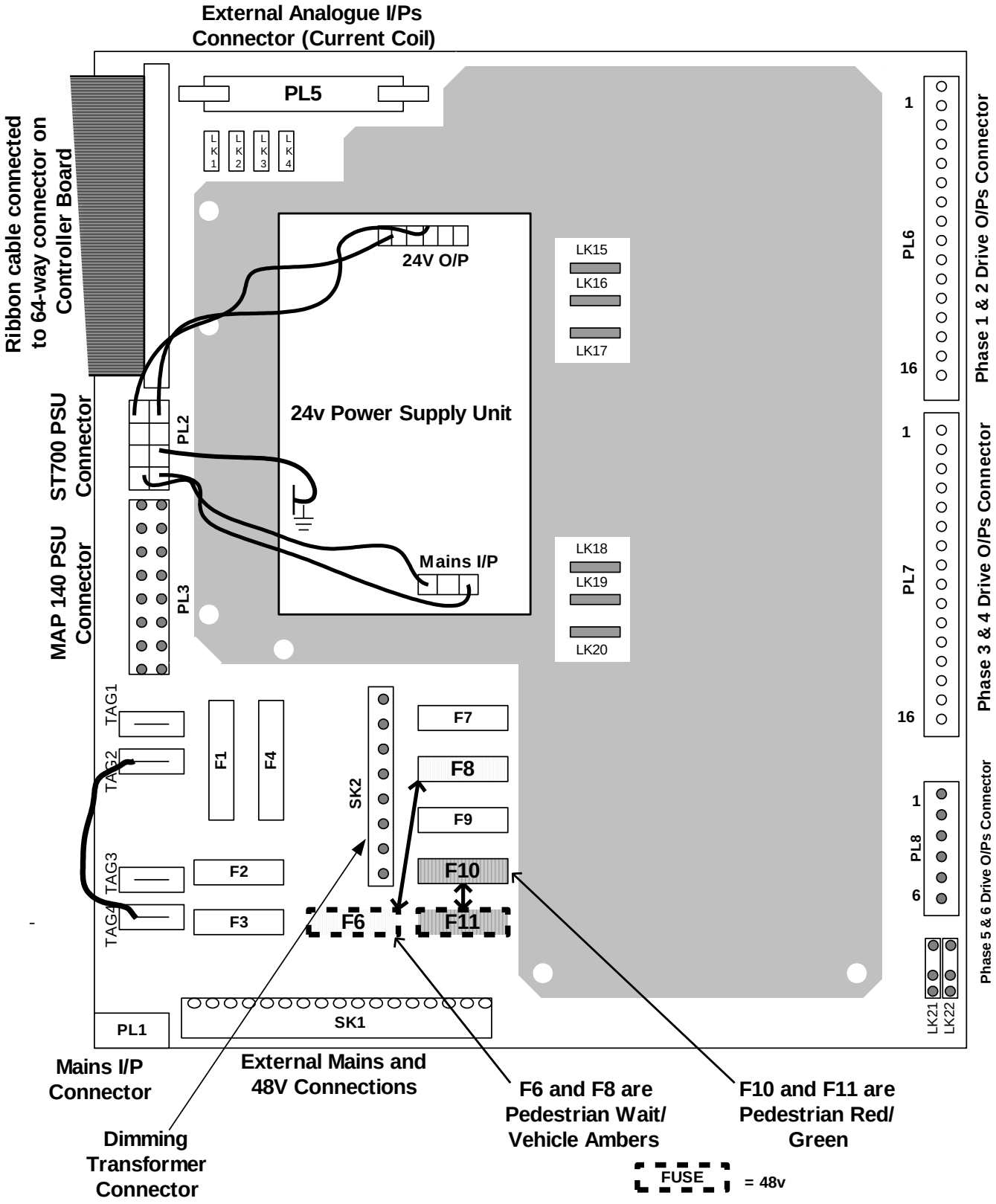


Figure 20 – ST700 Phase Drive PCB Assembly

5.15.2.1 Fuse/Dummy Fuse Settings

The output voltage for the Pedestrian Red and Pedestrian Green can be set to either 230V or 48V operation. Fitting the fuse and dummy fuse as follows sets the voltage:

- For **230V** operation fit the 10A fuse in F10 and the dummy fuse in F11.
- For **48V** operation fit the 10A fuse in F11 and the dummy fuse in F10.

The output voltage for the Pedestrian Waits can be set to either 230V or 48V operation. Fitting the fuse and dummy fuse as follows sets the voltage:

- For **230V** operation fit the 10A fuse in F8 and the dummy fuse in F6.
- For **48V** operation fit the 10A fuse in F6 and the dummy fuse in F8.

Note: The dummy fuse is a plastic spacer, the same size as the fuse it replaces. It is used to prevent service personnel inserting an extra fuse and thus causing damage to occur to the ST700.

5.15.2.2 Blue and Red Handbag Links Settings

The output voltage monitoring circuits for the Pedestrian Red and Pedestrian Green can be set to monitor either 230V or 48V. Inserting the correct coloured handbag links on the board sets the voltages for the Monitoring circuit. The positions and colours are as follows:

- For **230V** operation fit only a Red Link in position LK22 (large pitch).
- For **48V** operation fit only Blue Links in positions LK22 (small pitch), LK15 and LK17. On 4 phase units fit LK18 and LK20.

Note: Links LK15, LK17, LK18 and LK20 are accessed through the two rectangular cut outs in the heatsink cover. See Figure 20 for details. A pair of long nose pliers is required to insert and extract the handbag links.

The output voltage monitoring circuits for the Pedestrian Wait can be set to monitor either 230V or 48V. Inserting the correct coloured handbag links on the board sets the voltages for the Monitoring circuit. The positions and colours are as follows:

- For **230V** operation fit only a Red Link in position LK21 (large pitch).
- For **48V** operation fit only Blue Links in positions LK21 (small pitch), LK16 and LK19.

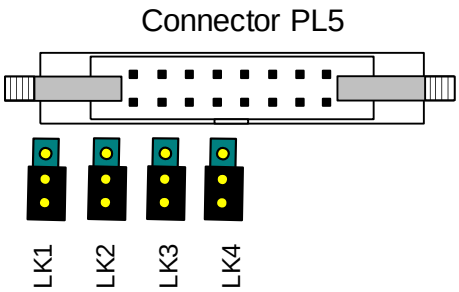
Note: Links LK16 and LK19 are accessed through the two rectangular cut outs in the heatsink cover. See Figure 20 for details. A pair of long nose pliers is required to insert and extract the handbag links. Both the Red and Blue links are wire shorting

links in the form of a handbag, with a handle to aid insertion and extraction. They fit into PCB mounted sockets and use spring clips in the socket to make the connection and fit. These spring clips also retain the link to the PCB; the contacts are gold plated for low resistance and reliability.

5.15.2.3 Links LK1, LK2, LK3 and LK4 Settings

The links LK1 to LK4 have handbag links fitted as shown in Figure 21 below. These should not be changed.

Figure 21 – Links LK1 to LK4



5.16 ON-SITE ST700 TESTING

Connect a suitable handset to the 25-way D-type connector on the ST700 Phase Drive PCB.

Replace each of the 4 off 10A fuses in the fuse holders F6 to F11 on the Phase Drive PCB with 3.15A fuses, leaving the dummy fuses in place. See Figure 23 and Figure 20 for details. This protects the individual circuits whilst the self-test is being performed in the event of a short circuit in any of the cables.

Select and run the self-test – see section 7.

If the self test passes, replace the 10A fuses in the Phase Drive PCB.

The ST700P stand-alone pedestrian controllers normally run one of the standard configurations generated by Siemens Poole that are listed below:

EM60700	Stand-alone Pelican crossing with MCE0125 style flashing green man / flashing vehicle amber.
EM60701	Stand-alone crossing with a red clearance period, i.e. TR0141C near-sided Puffin or Toucan crossing.
EM60702	Stand-alone crossing with a blackout clearance period, i.e. TR0141C far-sided Pedestrian, Puffin or Toucan crossing.

These configurations are available on the IC4 CD. Other configurations may be produced by Siemens Poole in order to meet the particular requirements of an area or of one particular site.

These configurations need to be customised for particular installations using the handset in a similar way to the T400 Pelican, using the information in the special instructions of the configuration printout.

The commands to customise the ST700 are described in the Handset Handbook and in the Special Instructions. These allow facilities such as kerbside and on-crossing detectors and speed discrimination/assessment to be enabled or disabled. However, the fundamental lamp sequence (i.e. flashing green-man, red-man or blackout clearance periods) cannot be changed using the handset and is fixed in each of the default configurations.

The configuration data for a stand-alone pedestrian crossing ST700 is loaded through the handset port from a PC running IC4.

The configuration data could be loaded while the ST700 is still in the depot rather than using a PC on the street. Provided the battery isolators are removed, the configuration data will still be present in the battery backed-up RAM when the ST700 is installed.

The procedure for loading the configuration data is given in the Handset Handbook.

Once the configuration data has been loaded, ensure the Signals ON/OFF switch on the manual panel is in the off position and connect a suitable handset to the 25-way D-type connector on the ST700 CPU PCB.

With all signals covered (bagged), use the LMP handset command, which causes each colour on each phase to illuminate in turn, whilst other persons are checking the aspects. Care must be taken to ensure that any traffic on the junction does not mis-read the signals and cause an accident. In addition, a visual check of the wiring must be carried out, to ensure that the individual approaches are wired correctly as shown in Figure 9.

The ST700 signals can now be switched on (using the switch on the manual panel) and the ST700 powered up normally.

If the solar cell and signal dimming are not required then the following test can be ignored.

1. Cover the photoelectric cell for at least one minute to exclude any light and check that the signals are dimmed.

2. Remove the cover from the photoelectric cell and after at least one minute the signals should revert to the bright condition.

If detectors are installed then they should be set up as defined in the Detector Information Handbook.

Set up the date and time.

Check that the Lamp Monitor has correctly learnt all the lamp loads, using the KML and KEL handset commands, described in the Controller Handset Handbook.

Check that there are no unexplained errors in the fault log.

This completes the testing and the site should be ready for Customer acceptance.

5.17 ST700 START-UP SEQUENCE

When the ST700 is initially powered up, it performs various internal checks before starting normal operation. While these checks are being performed the green heartbeat LED flickers and the red system error LED remains on.

If these tests fail then there is a serious fault on the CPU PCB and the PCB should be replaced. The error message is repeatedly written to the handset display at 1200 baud, and no other handset operations can take place:

`RAM FAULT`	for RAM read/write test fail
`DPR RAM FAULT`	for RAM read/write test fail (Dual Port RAM)
`PRG PROM FAULT`	for program PROM fail
`XTL FAULT`	for CPU and RTC crystal check fail

In addition to the above internal checks, the ST700 goes on to check the contents of its battery backed RAM, e.g. the fault log and checksum on the timings data, before attempting to switch on the signals.

Once the ST700 is running normally, it extinguishes the red system error LED and the green heartbeat LED flashes.

If the red system error LED remains illuminated then a handset should be connected and the fault log checked to see what errors exist. The fault log is described in the Handset Handbook.

5.18 REFITTING THE LID

Reconnect the earth lead by fitting the Faston connector to the Faston Tag. Replace the Lid carefully on the equipment mounting frame and secure the Lid to the frame using the ‘T’ key.

5.19 FITTING THE ST700 RACK ASSEMBLY INTO ALTERNATIVE CABINETS

DISCONNECT ALL POWER TO THE CABINET BEFORE REMOVING OR INSTALLING ANY EQUIPMENT INTO THE CABINET.

The ST700 Rack Assembly may be fitted into enclosures other than the ST700 Cabinet Assembly. In the UK, the Cabinet must be one that has previously been approved with a different controller. Some examples are:

ST800
T200
T400S
T400L
GEC110/125
CST – McQue
T110
T500P
GEC125 in 25 Case
Microsense Midi

The procedure for each type of Cabinet depends largely on the type and condition of the existing equipment. For this reason it is not possible to define in detail exactly what should be undertaken, but generally the procedure follows that defined in sections 5.1 to 5.16.

For some Cabinets, conversion kits of parts are available. These provide brackets and other equipment that may be helpful during the installation. Part numbers for the spares available at the time of issue of this handbook are listed in Appendix A.

5.20 COMMON RETURNS FOR PUSH BUTTON

For the connections for the common returns see the following drawings :-

ST700S - 667/CC/29000/001
ST700/400S - 667/CC/29000/002
ST700L - 667/CC/29000/003

5.21 COMMON RETURNS FOR DETECTORS

For the connections for the common returns see the following drawings :-

ST700S - 667/CC/29000/001
ST700/400S - 667/CC/29000/002
ST700L - 667/CC/29000/003

6. ROUTINE MAINTENANCE PROCEDURES

This section contains a list of checks to be performed at an ST700 on a regular basis (normally annually).

If for any reason, the power is switched off to the ST700, then a total installation megger test should be carried out, as defined in the General Testing Handbook.

6.1 ROUTINE INSPECTION OF SIGNAL EQUIPMENT

Check all signal heads/aspects for damage and take any necessary corrective action.

Check all signal heads for correct alignment with their respective approaches.

Check all pole top cable connections; ensure that they are sound, secure and not seriously corroded.

Check that all top caps are fitted and are not damaged.

Check that all poles are secure in the ground and are not leaning or damaged.

6.2 ROUTINE INSPECTION AND ELECTRICAL TESTING OF ST700

It is suggested that these procedures be performed in the order listed.

Examine the Lid and equipment mounting frame for serious damage. The Lid would normally only be replaced if it has been damaged to the extent that its security has been breached or that water or dirt is entering.

Open the door(s), both the main (if the cabinet has one) and the manual panel; check that the screw-locks, lock and hinges operate freely. Inspect the door and lock, and check the lock and catch-plate for security. Replace or tighten as necessary. Lubricate as necessary with good quality penetrating type oil.

Undo the fixing bolt(s) and remove the Lid. Check the condition of the fixing bolts and their associated chassis fixing thread, clean both and lubricate as necessary with good quality oil. Inspect the stool-to-assembly seal and replace if necessary.

Inspect the manual panel gasket, ensuring it is intact and in the correct position. Replace as necessary ensuring that the surface is clean before fitting.

Check the manual panel for any damage and replace if necessary. Check that all functions operate correctly. Press the lamp test keypad and check that all LEDs are operational.

The following tests will result in the signals extinguishing.

- Test the 300mA RCD (if fitted) by pressing the test button. The breaker should operate immediately.

- Check the termination panel(s) and master switch panel within the Cabinet and ensure that there are no loose fixings, or damage to these panels. Tighten any loose fixings and carry out any repairs that are necessary.

- Check the logic assembly and other assemblies within the ST700 are securely fixed. Retighten loose fixings as necessary.

- Check that all fuses are secure in their holders. **It is strongly recommended that the ST700 supply is isolated before any fuses are checked**.

- Check wiring and cableforms, particularly ribbon cables for damage. Replace or re-route as appropriate.

- The battery on the ST700 CPU PCB must be replaced if it has failed. Any replacement battery should be suitably marked with an appropriate date label. Having done this, the ST700 records should be updated accordingly.

The following tests require the ST700 to be powered and running normally.

- Tests of the Voltage Drop of Neutral Conductors. This test should be carried out during each periodic/annual inspection as a simple check of neutral cables, which can also provide a good indication of the state of the intersection cabling.

    (i) Take a digital multi-meter or voltmeter and set it to measure 240 volts AC (RMS).

    (ii) Select a phase and wait until its green has just terminated. Measure the voltage between the Cabinet Assembly neutral and the green feed; the voltage should be no greater than 4 volts (RMS) throughout the signal cycle, except when the phase next goes to green. If the voltage between the green feed and neutral is greater than 4 volts then do the following:

        (1) Check all joints in the appropriate neutral cable run, ensure that they are all tight and none are seriously corroded, replace or tighten them as necessary.

        Re-test cable

        If the fault still persists then:

        (2) Increase the number of conductors/cable cores used for the neutral.

        Or

        (3) Replace the cable that has failed the test.

Re-test the cable to ensure that corrective action taken has removed the problem.

- With the handset, check that all inputs used are operating correctly.

- Test the maintenance socket RCD by pressing the test button. The breaker should operate immediately.

The following checks should be carried out before leaving the site.

- Check the manual panel gasket is intact and in the correct position. Replace as necessary ensuring the surface is clean before fitting.

- Inspect the cabinet base seal. If damaged, the affected area should be filled with sand and re-sealed. For details see section 5.11.

6.3 ROUTINE SETUP CHECK

Check that the real time clock is set correctly as described in the Controller Handset Handbook.

Use the time of day TOD command to check that the real time clock is running the correct time. A true measurement of the accuracy of the real time clock can only be gained if the clock with which it is compared has been accurately set up.

It is essential that the time be compared with an adjacent installation using a clock that has been synchronised to that installation within the last 30 minutes.

6.4 REPLACEMENT OF PCBS

This section covers the removal and fitting of PCBs in the ST700. Safety requirements and procedures are described to ensure that the board functions correctly when fitted (e.g. PROM fitting).

When replacing PCBs only approved spares must be used. Use of any other components may invalidate the Type Approval of the equipment.

Note that PCBs are not generally available separately as spares, but are included in kits. If a PCB fails a new board may be taken from the replacement kit, or the whole kit may be replaced. See Appendix A for part numbers.

6.4.1 Safety Requirements

Before replacing any fuses, PCBs etc., **IT IS ESSENTIAL THAT THE POWER TO THE ST700 IS ISOLATED**. See the Safety Warning on page 2 for details.

Failure to isolate the supply before changing parts may result in damage to the ST700.

6.4.2 General Requirements

When replacing PCBs the original PCB should be inspected and the following points checked:

(a) Check the connectors on the PCB. Are any pins bent, broken or damaged in any way? If there are, make a note of the PCB and pin number in the Controller Visit Log Book as the ribbon backplanes may have been damaged.

(b) Check any ICs that are mounted in sockets and ensure that they are the correct ones for the position and are securely fitted. Refer to the works specification for further details.

A problem with a loose fitting IC or use of an incorrect one can usually be rectified easily without having to fit a replacement PCB.

(c) Do not forget to record the replacement in the Controller Visit Log Book.

6.4.3 Access to PCBs in ST700 Cabinet Assembly

The ST700 CPU PCB is mounted directly on the outside of the ST700 Rack Assembly hinged front plate and is easy to access once the Lid is removed from the equipment mounting frame.

If a fault is suspected with the Phase Drive PCB, the whole Power/Phase assembly is replaced as described in section 6.4.6.

If fitted, the I/O Board or OTU Board are fitted inside the ST700 Rack Assembly, behind the CPU PCB.

Warning: To open the hinged plate, the 64-way Phase Control Ribbon cables at the front of the ST700 Rack Assembly must be disconnected. Disconnection of the cable disconnects all logic power from the CPU and therefore prevents the ST700 operating the lights, **but it does not switch the incoming mains off**. The mains must be isolated at the master switch before any disconnection of cables or fuse replacement takes place.

6.4.4 Access to PCBs in other Outercases

All ST700 Rack Assemblies installed in cabinets with 19” mounting kits provide full access to the front face of the ST700 and have sufficient room to allow the hinged front plate to swing open, giving access to the internal PCBs.

Access to the PCBs is the same as described in section 6.4.3.

6.4.5 Replacement of CPU PCB

Ensure that the replacement PCB has the correct firmwares fitted and they are of the correct variant and issue. Refer to the Works Order Specification for details.

The mounting pillars on the CPU are a nylon clip type and only require the clipping mechanism to be released to allow the board to be removed. The pillars are retained on the hinge plate by means of an integral clipping mechanism on the other end. When the CPU is replaced, make sure that the clipping mechanism of the mounting pillar is fully engaged.

Warning Care must be exercised when removing or inserting the green connectors and their cables from the PCB, as strong extraction and insertion forces are required. Be careful not to over flex the board, which could cause tracks to fracture and the board to fail.

6.4.6 Replacement of Power/Phase Assembly

The Power/Phase assembly may be removed once the following have been carried out:

- Isolate the Mains to the ST700 at the master switch
- Disconnect the 64-way Phase Control ribbon cable from the CPU
- Unclip the earth lead from the hinged front plate
- Remove the front plate[2] holding the CPU (and I/O or OTU) and store carefully
- Disconnect the earth wires from the fixing point in the assembly
- Disconnect PL6, PL7, PL8 and SK2
- Disconnect PL1 and SK1.

Warning Care must be exercised when removing or inserting the green connectors and their cables from the PCB, as strong extraction and insertion forces are required. Be careful not to over flex the board, which could cause tracks to fracture and the board to fail.

Using a 10” Pozidriv No.1 screwdriver, loosen (do not remove) the four screws holding the Power/Phase assembly to the equipment mounting plate. Lift the assembly off the mounting plate.

Replace with the new Power/Phase assembly, checking that the part numbers are the same, i.e. 2 phase, 4 phase or 6 phase unit.

Ensure that all links and fuses are set correctly (i.e. in the same position as the original unit) as described in section 5.15.
Reconnect PL1, PL6, PL7, PL8, SK1, SK2 and the earth wires.

[2] The front plate needs to be at 90º when it is fitted or removed. Push the front plate up and remove from the bottom hinge pin. Pull down to release the front plate from the top hinge pin.

Replace the hinged front plate holding the CPU PCB and, if fitted, the I/O or OTU PCB.
Replace all the cables to the CPU. Clip the earth lead to the front plate.
Restore power to the ST700.

Note: The new Power/Phase assembly is supplied with a chassis door fitted. It is not necessary to replace the door when the Phase Drive PCB has failed. The old Power/Phase assembly should be returned to Siemens Poole with the replacement door.

6.4.7 Replacement of Manual Panel PCB

First unplug the cable connecting the manual panel to the CPU PCB.

The manual panel is held to the main Cabinet Assembly by a number of screws that need to be removed. After removing these screws the panel may remain held in place by the sealing strip. Ease the panel away from the housing, gradually working from one corner, taking care not to scratch or otherwise damage it.

The replacement panel should be mounted with a new sealing strip to prevent water ingress. After fitting, reconnect the cable to the CPU PCB.

Where an Internal Manual panel is fitted, it may be removed directly by removal of the screws holding it to the 19 inch panel; it may be easier to remove the 19 inch panel from the rack first. No sealing is required on refitting.

6.4.8 Replacement of Expansion I/O or OTU PCB

Removal of the I/O or OTU PCB may be done once the Mains to the ST700 Rack Assembly has been isolated at the master switch, the 64-way Phase Control ribbon cable has been disconnected from the CPU and the hinged front plate has been opened.

Ensure that the replacement PCB has the correct firmware and PLD fitted at the correct variant and issue. Refer to the Works Order Specification for details.

The I/O or OTU PCB is removed by removal of the screw fixings (4 off) which secure it to the inside surface of the hinge plate. Ensure all the cables are fully disconnected before the board is removed, and fully inserted following the replacement of the board.

6.5 REPLACEMENT OF MAINS POWER SUPPLY UNIT

The spare Mains Power unit is provided as part of the Power/Phase Assembly. It is not necessary to replace the whole assembly if the power unit has failed, providing the failure has not damaged other components.

The Mains PSU may be removed once the following have been carried out:

- The Mains to the ST700 Rack Assembly has been isolated at the master switch
- The 64-way Phase Control ribbon cable has been disconnected from the CPU
- The hinged front plate has been opened.

Remove the cables and connectors connected to the PSU, then release the nylon mounting pillar clips that attach the PSU to the heatsink cover of the Phase Drive PCB. The clips are retained on the heatsink cover by means of an integral clipping mechanism on the other end.

When the PSU is replaced, ensure that the clipping mechanism of the mounting pillar is fully engaged and all the cables and connectors are securely fitted.

Re-assemble the Rack Assembly.

6.6 REPLACING OTHER COMPONENTS

Only approved spares must be used when replacing any components. Use of any other components may invalidate the Type Approval of the equipment.

7. SELF-TEST FACILITY

The self-test facility can be used to check the hardware fitted to the controller, even before a configuration is loaded. It is designed to be used both in the factory by production and on the street by installation/ maintenance engineers.

Self-test is initiated by holding down the level 3 access button while switching on the power to the controller. The button should be released once the green heartbeat LED starts to flash.

The green heartbeat LED continues to flash during the self-test unless a fault is detected when the red system error LED illuminates.

Connecting a 20 character by 4 line handset displays information about the checks it is performing, such as the firmware issue and the lamp supply voltage, both dim and bright, and detail any faults found.

Self-test performs the checks detailed on the following pages and produces error messages if faults are detected.

While the self-test is running, the manual panel can be checked. Pressing each button on the panel should illuminate the associated LED. To distinguish this from normal operation, the LED flashes at a fast rate while the button is depressed. Note that the 'Lamp Test' button illuminates all the LEDs, as it does for normal operation.

To test the signals on/off switch and the cabinet alarm LED, switching the switch to the signals 'on' position illuminates the cabinet alarm. Switching it to the 'off' position extinguishes the cabinet alarm indicator. Note that the signals on/off switch does not affect the self-test in any other way.

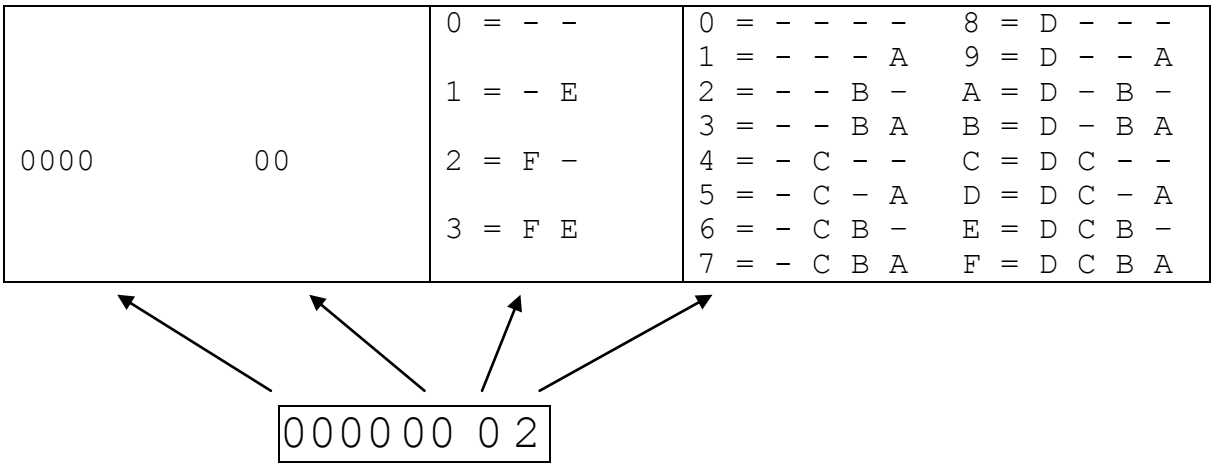
- **Resolving problems with lamp switch cards and triacs:**

When various tests fail, the handset may display information such as:

```
No voltages on:          ← identifies the test which has failed
R-00000000+00000000      ← outputs from the red voltage monitors
A-00000002+00000002      ← outputs from the amber voltage monitors
G-00000000+00000000      ← outputs from the green voltage monitors
  -ve Peak  +ve Peak
```

The numbers are in hexadecimal notation and so each of the eight digits encodes four phases, as follows:

Figure 22 – Handset



So in the above example, there are no voltages on Phase B amber (or Wait). Has the wait fuse blown?

- **On power-up, the self-test facility checks the integrity of the main processor board:**

```
RAM FAULT
DPR RAM FAULT
PRG PROM FAULT
XTL FAULT
DPR R/W FAULT
```

All the above faults point to problems internally on the main processor card.

- **Checks communications with the secondary / phase bus processor:**

```
P/Bus CPU....
```

If the processor cannot be detected, then the self-test will wait indefinitely at this point with the red system error LED illuminated. Check that the processor and its firmware are fitted.

- **Examines the lamp switch cards to see how many are fitted:**

```
No L/S Cards Found
```

No cards were detected. Either the lamp switch or the processor PCB could be faulty.

- **Waits for ZXO synchronisation and checks the mains frequency:**

```
ZXO Sync'd...
```

If the phase bus processor cannot synchronise to the mains zero cross-over signal, then self-test will wait indefinitely at this point with the red system error LED flashing.

```
Mains Freq Error
```

If the mains frequency is more than 5% out from either 50Hz or 60Hz.

- **Checks all the ADC test voltages on all of the lamp switch cards:**

```
ADC Tests....Failed
ADC Test Readings
    0.0V 2.5V 5.0V
B0+ nnnn nnnn nnnn
B0- nnnn nnnn nnnn
... .... .... ....
```

If the test fails, then the readings from each board, taken at both the positive and negative mains peaks for each of the two test voltages (0V and 2.5V) are displayed on the handset.

Ideally the values should be 0 and 128.

- **Checks that the lamp supply and voltage monitors are detecting no mains:**

```
L/Supply Off=240V
L/Supply Stuck On
```

If a lamp supply is being detected, then this implies that the lamp supply relays are all switched on (very unlikely) or the lamp supply monitoring transformer (on the power distribution card) has failed.

```
V/Mons Off...Failed
R-00000000+00000001
A-00000000+00000000
G-00000001+00000000
```

If any of the voltage monitors appear to be detecting mains, even though the lamp supply and all the triacs are switched off, then this implies a problem with the hardware on the lamp switch card.

- **Initialises the phase bus processor:**

```
P/Bus Init...
```

```
Bad L/S Cards
```

Once initialised, the phase bus processor performs more thorough checks on the lamp switch card and may detect faults.

- **Checks the monitor validation signal:**

```
M/V Test ....Failed
Mon Val Failed
```

The monitor validation signal is generated by the main processor to check the phase bus processor, so a failure is probably due to a faulty processor card.

- **Step 1 Complete, Start Step 2:**

At this point, the self-test has successfully checked-out the logic side of the cards. It then displays a scrolling pattern on the amber LEDs to show that the first part of the self-test is complete.

This pattern remains until the operator presses the level 3 button to confirm that the self-test may switch on the lamp supply and continue its tests.

After the level 3 button is pressed, self-test switches on the lamp supply.

Towards the end of this second sequence of tests, it tests all the triacs by switching each one on in turn for a very short period of time.

If standard HI 12V halogen lamps are used (with a transformer in the signal head), then this pulse will not be seen on the street and so the signals need not be covered. However it may be possible to see the pulse on lamps that are not driven by any transformer, i.e. that run directly off the 240V.

If in doubt, all non-HI signal heads, i.e. 240V lamps, LED Signals and 48V ped signals, should be covered before proceeding any further with the self-test.

- **Self-test switches on the lamp supply and then checks that the voltage monitors still show no mains (triacs still switched off):**

```
V/Mons Off...Failed
R-00000000+00000001
A-00000000+00000000
G-00000001+00000000
```

If any of the voltage monitors appear to be detecting mains, then it would imply that those triacs are not holding off the mains and the lamp switch card should be replaced.

- **L/S Supply Failure:**

```
L/S Monitor Fault
```

The lamp supply can be detected on the voltage monitors, but no signal is present from the lamp supply monitoring transformer. Replace the lamp switch card.

```
L/Supply Failure
```

No lamp supply has been detected by the lamp supply monitoring transformer but further investigations by the self-test facility cannot determine the cause. Check the lamp supply circuits relays, fuses, etc., in and around the power distribution unit.

Also check that the dim connector SK2 is connected. N.B. Links are required on this connector even if no transformer is required.

- **Checks that each lamp supply relay can switch off the lamp supply independently:**

```
SSR Fault
Relay A Fault
Relay B Fault
```

Failure of any of these tests implies that the relay is not switching off, i.e. that it is either welded closed or the control signals from the main processor card are stuck active.

- **Checks that the dimming relay is functioning:**

```
Dimming Fault
```

A fault is only logged on the dimming relay if the dim lamp supply is more than 75% of the normal lamp supply, i.e. that the dimming relay seems to have no effect on the lamp supply.

Note that this test does not fail if there is no dim lamp supply, e.g. if no dimming transformer is fitted, since self-test may be performed on the just the controller rack. Therefore, the dim voltage should be checked manually, e.g.

```
Dim L/Supply=160V
```

- **Checks all of the triacs in turn by applying a very short pulse to each phase's colour:**

```
A/Red:Extra Sigs On
R-00000001+00000001
A-00000001+00000001
G-00000001+00000001
```

A fault will be logged if extra signals are detected as on when one particular aspect is pulsed. This would normally imply a short-circuit in the street cabling or a open neutral connection.

```
No Voltages On...
R-00000000+00000000
A-0000000A+0000000A
G-00000000+00000000
```

A fault will also be logged if no voltages were detected, e.g. when one of the fuses has blown.

In the example above, 0000000A represents phases B and D (see Figure 22), so Amber (from RAG down the left-hand side) shows that the pedestrian Wait indicators have no voltages present. Check the fuses F6 and F8 and the 48V output from the dimming transformer for example.

At the end of the test, the self-test switches off the lamp supply and displays a multicoloured scrolling pattern on the LEDs to show that all the tests have passed successfully.

It also illuminates a series of LEDs to identify which cards on the extended system bus have been detected. A full list is displayed on the handset.

After a few seconds, self-test will repeat the second part of the self-test allowing the controller to be soak tested.

8. HANDBOOK OMISSIONS/PERSONAL NOTES

This handbook cannot be deemed to be all encompassing as everyone has different experiences of faults and different techniques for finding faults. Therefore, this section has been provided in which any faults experienced by an engineer which are not mentioned in this handbook can be noted along with the technique used to find the fault. Any personal techniques used to find other faults that may differ from those techniques described in this manual might also be noted in this section. Either or both of the following sheets should be filled out if the engineer feels that they should be added to the handbook, to draw their contents to the attention of other users. Then a copy of the completed sheets should be sent to:

The Traffic Engineering Department
(Traffic Controller Section)
Siemens Traffic Controls Ltd
Sopers Lane
Poole
Dorset
BH17 7ER
England

For consideration and addition if applicable.

Engineer _____
Date _____
Address _____
_____

Fault Symptoms

Rolling Log Contents

Fault Flags and Data Contents

ENGINEER _____
Date _____
Address _____

Actual Fault

Technique used to find fault

Other Observations and Notes

9. FAULT INFORMATION FORM

This section provides a blank Fault Information Form. If there any problems that require the assistance of technical support either from the depots or from Poole, a completed copy of this form will assist in diagnosing the problem.

A copy of the completed form should be sent to:

The Traffic Engineering Department
(Traffic Controller Section)
Siemens Traffic Controls Ltd
Sopers Lane
Poole
Dorset
BH17 7ER
England

FAULT INFORMATION FORM

Site name: _____ Date / Time: ___ / ___ / ___ ___ : ___

Engineer's name: _____ Telephone: _____

Reason for visit: _____

Controller Checks Before Resetting Faults

Are the signals still on?	On ❑	Off ❑	System error LED?	On ❑	Off ❑
Green heartbeat LED?	On ❑	Off ❑	Bus error LED?	On ❑	Off ❑
If on, is it still beating?	Yes ❑	No ❑	Watchdog error LED?	On ❑	Off ❑

Enter the following commands and record the responses:

TOD	_____	PIC	_____
CIC	_____	SIC	_____

Type 'FFS' and use the '+' key to scroll through the currently active fault log flags until 'FFS END OF LOG' is displayed.

FFS	_____	+	_____
+	_____	+	_____

Type 'FDS' and use the '+' key to scroll through the currently active fault log data until 'FDS END OF LOG' is displayed:

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

If FFS 55 was set, i.e. if 'FFS 55:255 LAMP' was displayed, then enter 'KLD' and use the '+' key to scroll through the lamp faults until 'KLD END OF LOG' is displayed and record each entry below:

KLD s a:nnnW p/ccccc	☑	☒	Examine the lamps around the junction.
_____	❑	❑	Replace any lamps that have been correctly reported as failed by KLD, tick the associated box and check that the fault is automatically cleared after about 10 seconds.
_____	❑	❑	
_____	❑	❑	
_____	❑	❑	If no lamp fault can be found on the junction for the displayed phase and colour, put a cross in the box and refer to the 'lamp monitor' section of the handbook.
_____	❑	❑	
_____	❑	❑	

Serial Numbers

If the power to the controller needs to be switched off in order to fix/clear the fault(s), then take this opportunity to record the board issues and serial numbers of the ST700 PCBs. Record the issue states and serial numbers of the main processor PCB and Phase Driver PCB.

CPU:..... Phase Driver PCB:.....

Controller Checks After Clearing Fault

Are the signals on?	Yes	❑	No	❑
Is the green heartbeat LED on and beating?	Yes	❑	No	❑
Is the red system error LED off?	Off	❑	On	❑
Is the lamp monitor learnt? (i.e. 'KML:Complete')	Yes	❑	No	❑
Is the time/date set-up correctly?	Yes	❑	No	❑

Use 'LOG' to look back through the historic rolling log and record the last few events. Press 'SP' (space) and then the '+' key to view the latest few records:

Date	Time	Event(s)

Record any relevant information in the controller's log book and record below the date, time and reason for the previous visit as described in the log book:

Any another comments?

Appendix A - PART NUMBERS AND SPARES LIST

Use of components other than those listed, or modifications or enhancements that have not been authorised by Siemens Traffic Controls Limited may invalidate the warranty or safety of this product.

A.1 – PART NUMBERS

Listed below are the currently available parts that make up the ST700. For an up to date list see the ST700 Shopping List (667/KM/27880/000).

Description	STCL Part Number
2 Phase Cabinet Assembly	667/1/27880/002
4 Phase Cabinet Assembly	667/1/27880/004
6 Phase Cabinet Assembly	667/1/27880/006
ST700 MEC Cabinet	667/1/27880/090

2 Phase Rack Assembly	667/1/27860/002
4 Phase Rack Assembly	667/1/27860/004
6 Phase Rack Assembly	667/1/27860/006

Kit Termination Detector Cable	667/1/15854/000
Detector Single Backplane Kit	667/1/15990/003
Locking Kit	667/1/21923/001
I/O Kit	667/1/27003/000
Integral OTU Kit	667/1/27004/000
SDE Facility Kit	667/1/27005/000
GPS Module Mod Kit	667/1/27014/000

Manual Panel (Ped full panel)	667/1/27056/002
Manual Panel (Blank)	667/1/27056/050
Manual Panel (Sigs On/Off)	667/1/27056/300
P/E Manual Panel + DFM Assembly	667/1/27056/301

DFM Lens Kit	667/1/27104/000
Manual Panel RS232 Kit	667/1/27110/000
300mA RCD Kit	667/1/27117/000
Lightning Suppression Kit	667/1/27118/000
24V AC Detector PSU Kit	667/1/27853/000
Dimming/48V Transformer Kit	667/1/27867/000
Controller Handset	667/4/13296/000
Current Monitoring Transformer	667/7/25171/000

GEC125/104 Conversion Kit	667/1/27855/000
CST – McQue Conversion Kit	667/1/27855/001
T110 Pole Mount Conversion Kit	667/1/27855/002
T500P Conversion Kit	667/1/27855/003

Description	STCL Part Number
GEC125 in 25 Case Conversion Kit	667/1/27855/004
T400S/T500S Conversion Kit	667/1/27855/005
Microsense Midi Conversion Kit	667/1/27855/006
T400L/T500L Conversion Kit	667/1/27855/007

A.2 – SPARES LIST

Listed here are the parts that should be used when replacing components. In addition to the spares listed here, many of the parts included in section A.1 above may be ordered as replacements. Contact Siemens Poole for details.

A.2.1 – PCBS

2 Phase Drive PCB with chassis	667/1/27870/002
4 Phase Drive PCB with chassis	667/1/27870/004
6 Phase Drive PCB with chassis	667/1/27870/006
CPU PCB	667/1/27831/001
2 Phase Drive PCB	667/1/27833/002
4 Phase Drive PCB	667/1/27833/004
6 Phase Drive PCB	667/1/27833/006

A.2.2 – FUSES

See Appendix A.3 for details of where these fuses are used

0.5A cartridge fuse	518/4/90285/004
16A HRC cartridge fuse (Pre Nov 2003)	518/4/90352/005
20A MCB SP C Type (Post Nov 2003)	516/4/97076/010
5A HRC cartridge fuse	518/4/90638/000
3.15A fuse	518/4/97020/115
5A HRC cartridge fuse	518/4/97052/017
10A cartridge fuse	518/4/90301/013
5A cartridge fuse	518/4/90301/010
16A HRC cartridge fuse	518/4/97056/012

A.2.3 – CABLES

CPU I/O Softwire kit	667/1/27863/100
Solar and Neutral Softwire kit	667/1/27872/000
Phase Softwire kit 2/4 phases (incl audio drives)	667/1/27877/000
Phase Softwire kit 5/6 phases (incl audio drives)	667/1/27877/050

A.2.4 – OTHER SPARES

Lithium 3V Battery	418/4/39829/000
Isolator Locking KOP	667/1/21923/001
Manual Panel – signs on off only	667/1/27056/010
CET Bar Kit	667/1/27845/000
Door Switch KOP	667/1/27852/000
Detector Mounting Frame	667/1/27854/000

Manual Panel Gasket	667/7/27129/000
Sealant Stool to Case	996/4/05032/003

A.3- FUSE RATINGS AND POSITIONS

Electricity Company Cut-out Fuse	The maximum size of this fuse should not exceed 100A (without reference to Poole). Maximum prospective short circuit current must not exceed 16,000A. Rating depends on application but 45A min is recommended up to 20A load
Master Switch Panel - MCB 516/4/97076/010	20A MCB SP C Type on the Master Switch Panel
Maintenance Socket Fuse 518/4/90638/000	5A HRC cartridge fuse to BS1361 marked 'MAIN,T' on Master Switch Panel.
Aux. Supply Fuse (If Din Rail Mounted) e.g. OTU/OMU 518/4/90638/000	5A HRC cartridge fuse to BS1361 marked 'OTU/AUX' on Master Switch Panel.
Aux. Supply Fuse (If Phase Drive PCB Mounted) e.g. OTU/OMU 518/4/97052/017	5A HRC cartridge fuse size 0 (32mm x 6.4mm) marked 'F4' on Phase Drive PCB
Controller Switch Fuse 518/4/97056/012	16A HRC cartridge fuse size 0 (32mm x 6.4mm) marked 'F1' on Phase Drive PCB
AC Detector Fuse 518/4/90301/010	5A cartridge fuse (20mm x 5mm) marked 'F3' on Phase Drive PCB.
Solar Cell Fuses 518/4/90301/010	5A cartridge fuse (20mm x 5mm) marked 'F2' on Phase Drive PCB.
230V R/A Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F9' on Phase Drive PCB.
230V Green Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F7' on Phase Drive PCB.
230V R/G Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F10' on Phase Drive PCB.
48V R/G Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F11' on Phase Drive PCB.
230V Amb/Wait Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F8' on Phase Drive PCB.

48V Wait Supply Fuse 518/4/90301/013	10A cartridge fuse (20mm x 5mm) marked 'F6' on Phase Drive PCB.
Input Protection and Audible Supply Fuse 518/4/90285/004	0.5A cartridge fuse (20mm x 5mm) marked 'F1 and Inputs' on CPU PCB.
Handset Fuse 518/4/90285/004	0.5A cartridge fuse (20mm x 5mm) marked 'F2 and Handset' on CPU PCB.
TEST Phase Drive PCB Fuses 518/4/97020/115	4 off 3.15A fuses used for initial testing on a rewired junction for self test. These fuses are for the temporary replacement of the fuses in positions F6 to F11 on the Phase Drive PCB.

Figure 23 - Fuse Ratings

Appendix B - Drawings

The drawings listed below are provided to assist with installation of the ST700.

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